SECTION 01010
GENERAL REQUIREMENTS

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1.1 GENERAL INTENTION

A. Contractor shall furnish all labor, materials, and equipment to perform and complete all work for Design-build to 750-Niche Columbarium, Project No. 833CM3025, Camp Nelson National Cemetery as required by drawings and specifications. See RFP scope of work.

B. Visits to the site by Bidders may be made only by appointment with the Cemetery Director.

E. All employees of general contractor and subcontractors shall comply with VA security management program and obtain permission of the VA police, be identified by project and employer, and restricted from unauthorized access.

F. Prior to commencing work, general contractor shall provide proof that a OSHA certified “competent person” (CP) (29 CFR 1926.20(b)(2) will maintain a presence at the work site whenever the general or subcontractors are present.

G. Training:

1. Beginning January 1, 2005, all employees of general contractor or subcontractors shall have the 10-hour—OSHA certified Construction Safety course and /or other relevant competency training, as determined by VA CP.
2. Submit training records of all such employees for approval before the start of work.

1.2 STATEMENT OF BID ITEM(S)

A. ITEM I: Work includes design-build for 750-Niche Columbarium at Camp Nelson National Cemetery. See RFP scope of work.

1.3 SPECIFICATIONS AND DRAWINGS FOR CONTRACTOR

Electronic documents for guidance will be provided to the contractor. Also see RFP scope of work for requirements.

1.4 FIRE SAFETY

A. Applicable Publications: Publications listed below form part of this Article to extent referenced. Publications are referenced in text by basic designations only.

1. American Society for Testing and Materials (ASTM):

E84-1998.....Surface Burning Characteristics of Building Materials

2. National Fire Protection Association (NFPA):

10-1998.....Standard for Portable Fire Extinguishers

FCLCH-30-2000.....Flammable and Combustible Liquids Code

51B-1999.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work

70-2000.....National Electrical Code

241-2000.....Standard for Safeguarding Construction, Alteration, and Demolition Operations

3. Occupational Safety and Health Administration (OSHA):

29 CFR 1926.....Safety and Health Regulations for Construction

B. Fire Safety Plan: Establish and maintain a fire protection program in accordance with 29 CFR 1926. Prior to start of work, prepare a plan detailing project-specific fire safety measures, including periodic status reports, and submit to Resident Engineer for review for compliance with contract requirements in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS. Prior to any worker for the contractor or subcontractors beginning work, they shall undergo a safety briefing provided by the general contractor’s competent person per OSHA requirements. This briefing shall include information on the construction limits, VAMC safety guidelines, means of egress, break areas, work hours, locations of restrooms, use of VAMC equipment, etc. Documentation shall be provided to the Resident Engineer that individuals have undergone contractor’s safety briefing.

C. Site and Building Access: Maintain free and unobstructed access to facility emergency services and for fire, police and other emergency response forces in accordance with NFPA 241.

D. Separate temporary facilities, such as trailers, storage sheds, and dumpsters, from existing buildings and new construction by distances in accordance with NFPA 241. For small facilities with less than 6 m (20 feet) exposing overall length, separate by 3m (10 feet).

E. Temporary Construction Partitions: N/A.

F. Temporary Heating and Electrical: Install, use and maintain installations in accordance with 29 CFR 1926, NFPA 241 and NFPA 70.

G. Means of Egress: Do not block exiting for occupied buildings, including paths from exits to roads. Minimize disruptions and coordinate with Resident Engineer and facility.
H. Egress Routes for Construction Workers: Maintain free and unobstructed egress. Inspect daily. Report findings and corrective actions weekly to Resident Engineer and facility Manager
I. Fire Extinguishers: Provide and maintain extinguishers in construction areas and temporary storage areas in accordance with 29 CFR 1926, NFPA 241 and NFPA 10.
J. Flammable and Combustible Liquids: Store, dispense and use liquids in accordance with 29 CFR 1926, NFPA 241 and NFPA 30.
M. Existing Fire Protection: Do not impair automatic sprinklers, smoke and heat detection, and fire alarm systems, except for portions immediately under construction, and temporarily for connections. Provide fire watch for impairments more than 4 hours in a 24-hour period. Request interruptions in accordance with Article, OPERATIONS AND STORAGE AREAS, and coordinate with Resident Engineer. All existing or temporary fire protection systems (fire alarms, sprinklers) located in construction areas shall be tested as coordinated with the medical center. Parameters for the testing and results of any tests performed shall be recorded by the medical center and copies provided to the Resident Engineer. Disregard if not in a medical center setting.
N. Smoke Detectors: Prevent accidental operation. Remove temporary covers at end of work operations each day. Coordinate with Resident Engineer. Disregard if not in a medical center settling.

O. Hot Work: Perform and safeguard hot work operations in accordance with NFPA 241 and NFPA 51B. Coordinate with Resident Engineer. Designate contractor's responsible project-site fire prevention program manager to permit hot work.
P. Fire Hazard Prevention and Safety Inspections: Inspect entire construction areas weekly. Coordinate with, and report findings and corrective actions weekly to Resident Engineer.
Q. Smoking: Smoking is prohibited in and adjacent to construction areas inside existing buildings and additions under construction. In separate and detached buildings under construction, smoking is prohibited except in designated smoking rest areas.
R. Dispose of waste and debris in accordance with NFPA 241. Remove from buildings daily.
S. Perform other construction, alteration and demolition operations in accordance with 29 CFR 1926.

T. If required, submit documentation to the Resident Engineer that personnel have been trained in the fire safety aspects of working in areas with impaired structural or compartmentalization features.

1.5 OPERATIONS AND STORAGE AREAS

A. The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Resident Engineer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

B. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Resident Engineer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

C. The Contractor shall, under regulations prescribed by the Resident Engineer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs sidewalks, or shallow underground utilities the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, shallow underground utilities, or roads.

D. Working space and space available for storing materials shall be as shown on the drawings.

E. Workmen are subject to rules of Cemetery applicable to their conduct.

F. Execute work so as to interfere as little as possible with normal functioning of Cemetery as a whole, including operations of utility services, fire protection systems and any existing equipment, and with work being done by others.

1. Do not store materials and equipment in other than assigned areas.
2. Schedule delivery of materials and equipment to immediate construction working areas in quantities sufficient for not more than two work days. Provide unobstructed access to Cemetery areas required to remain in operation.

3. Where access by Cemetery personnel to vacated portions of buildings is not required, storage of Contractor's materials and equipment will be permitted subject to fire and safety requirements.
4. Contractor employee parking will be limited to fenced storage areas as shown on the Drawings.

F. Utilities Services: Where necessary to cut existing pipes, electrical wires, conduits, cables, etc., of utility services, or of fire protection systems or communications systems (except telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer. All such actions shall be coordinated with the Utility Company involved:
1. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor. Contractor shall administer, coordinate and install all connections.

G. Phasing: To insure such executions, Contractor shall furnish the Resident Engineer with a schedule of approximate phasing dates on which the Contractor intends to accomplish work in each specific area of site, building or portion thereof. In addition, Contractor shall notify the Resident Engineer two weeks in advance of the proposed date of starting work in each specific area of site, building or portion thereof. Arrange such phasing dates to insure accomplishment of this work in successive phases mutually agreeable to Cemetery Director, Resident Engineer and Contractor.

I. Construction Fence: Before construction operations begin, Contractor shall provide a chain link construction fence, 2100 mm (seven feet) minimum height, around the construction area indicated on the drawings. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 15 inches. Bottom of fences shall extend to one inch above grade. Remove the fence when directed by Resident Engineer.

J. When a site is turned over to Contractor, Contractor shall accept entire responsibility therefore.

K. Utilities Services: Maintain existing utility services for Cemetery at all times. Provide temporary facilities, labor, materials, equipment, connections, and utilities to assure uninterrupted services. Where necessary to cut existing water, gases, sewer or air pipes, or conduits,

wires, cables, etc. of utility services or of fire protection systems and communications systems (including telephone), they shall be cut and capped at suitable places where shown; or, in absence of such indication, where directed by Resident Engineer.

1. No utility service such as water, gas, steam, sewers or electricity, or fire protection systems and communications systems may be interrupted without prior approval of Resident Engineer. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished, work on any energized circuits or equipment shall not commence without the Cemetery Director’s prior knowledge and written approval.
2. Contractor shall submit a request to interrupt any such services to Resident Engineer, in writing, 48 hours in advance of proposed interruption. Request shall state reason, date, exact time of, and approximate duration of such interruption.
3. Contractor will be advised (in writing) of approval of request, or of which other date and/or time such interruption will cause least inconvenience to operations Cemetery . Interruption time approved by Cemetery may occur at other than Contractor's normal working hours.
4. Major interruptions of any system must be requested, in writing, at least 15 calendar days prior to the desired time and shall be performed as directed by the Resident Engineer.
5. In case of a contract construction emergency, service will be interrupted on approval of Resident Engineer. Such approval will be confirmed in writing as soon as practical.
6. Whenever it is required that a connection fee be paid to a public utility provider for new permanent service to the construction project, for such items as water, sewer, electricity, gas or steam, payment of such fee shall be the responsibility of the Government and not the Contractor.

L. Abandoned Lines: All service lines such as wires, cables, conduits, ducts, pipes and the like, and their hangers or supports, which are to be abandoned but are not required to be entirely removed, shall be sealed, capped or plugged. The lines shall not be capped in finished areas, but shall be removed and sealed, capped or plugged in ceilings, within furred spaces, in unfinished areas, or within walls or partitions; so that they are completely behind the finished surfaces.

M. To minimize interference of construction activities with flow of Cemetery traffic, comply with the following:

1. Keep roads, walks and entrances to grounds, to parking and to occupied areas of buildings clear of construction materials, debris

and standing construction equipment and vehicles. Wherever excavation for new utility lines cross existing roads, at least one lane must be open to traffic at all times.

2. Method and scheduling of required cutting, altering and removal of existing roads, walks and entrances must be approved by the Resident Engineer.

N. Coordinate the work for this contract with other construction operations as directed by Resident Engineer. This includes the scheduling of traffic and the use of roadways, as specified in Article, USE OF ROADWAYS.

O. Coordination of Construction with Cemetery Director: The burial activities at a National Cemetery shall take precedence over construction activities. The Contractor must cooperate and coordinate with the Cemetery Director, through the Resident Engineer, in arranging construction schedule to cause the least possible interference with cemetery activities in actual burial areas. Construction noise during the interment services shall not disturb the service. Trucks and workmen shall not pass through the service area during this period:

1. The Contractor is required to discontinue his work sufficiently in advance of Easter Sunday, Mother's Day, Father's Day, Memorial Day, Veteran's Day and/or Federal holidays, to permit him to clean up all areas of operation adjacent to existing burial plots before these dates.
2. Cleaning up shall include the removal of all equipment, tools, materials and debris and leaving the areas in a clean, neat condition.

1.6 ALTERATIONS

A. Survey: Before any work is started, the Contractor shall make a thorough survey with the Resident Engineer of all areas in which alterations occur and areas which are anticipated routes of access, and furnish a report, signed by both, to the Contracting Officer. This report shall list by rooms and spaces:

1. Existing condition and surfaces not required to be altered throughout affected area.
3. Shall note any discrepancies between drawings and existing conditions at site.
4. Shall designate areas for working space, materials storage and routes of access to areas within the site where alterations occur and which have been agreed upon by Contractor and Resident Engineer.

B. Any items required by drawings to be either reused or relocated or both, found during this survey to be nonexistent, or in opinion of Resident Engineer to be in such condition that their use is impossible or impractical, shall be furnished and/or replaced by Contractor with new items in accordance with specifications which will be furnished by Government. Provided the contract work is changed by reason of this subparagraph B, the contract will be modified accordingly, under provisions of clause entitled "DIFFERING SITE CONDITIONS" (FAR 52.236-2) and "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 01001, GENERAL CONDITIONS.

C. Re-Survey: Thirty days before expected partial or final inspection date, the Contractor and Resident Engineer together shall make a thorough re-survey of the areas involved. They shall furnish a report on conditions then existing, surfaces, structures and grounds as compared with conditions of same as noted in first condition survey report:
   1. Re-survey report shall also list any damage caused by Contractor to such surfaces, structures and grounds despite protection measures; and, will form basis for determining extent of repair work required of Contractor to restore damage caused by Contractor's workmen in executing work of this contract.

D. Protection: Provide the following protective measures:
   1. Wherever existing roof surfaces are disturbed they shall be protected against water infiltration. In case of leaks, they shall be repaired immediately upon discovery.
   2. Temporary protection against damage for portions of existing structures and grounds where work is to be done, materials handled and equipment moved and/or relocated.
   3. Protection of interior of existing structures at all times, from damage, dust and weather inclemency. Wherever work is performed, floor surfaces that are to remain in place shall be adequately protected prior to starting work, and this protection shall be maintained intact until all work in the area is completed.

   2. Do not perform dust producing tasks within occupied areas without the approval of the Resident Engineer. For construction in any areas that will remain jointly occupied by the Cemetery and Contractor’s workers, the Contractor shall.

D. Final Cleanup:
   1. Upon completion of project, or as work progresses, remove all construction debris from above ceiling, vertical shafts and utility chases that have been part of the construction.

2. Perform HEPA vacuum cleaning of all surfaces in the construction area. This includes walls, ceilings, cabinets, furniture (built-in or free standing), partitions, flooring, etc.
3. All new air ducts shall be cleaned prior to final inspection.

1.7 DISPOSAL AND RETENTION

A. Materials and equipment accruing from work removed and from demolition of buildings or structures, or parts thereof, shall be disposed of as follows:
1. Reserved items which are to remain property of the Government are noted on drawings or in specifications as items to be stored. Items that remain property of the Government shall be removed or dislodged from present locations in such a manner as to prevent damage which would be detrimental to re-installation and reuse. Store such items where directed by Resident Engineer.
2. Items not reserved shall become property of the Contractor and be removed by Contractor from Cemetery.

1.8 **PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS**

A. The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

B. The Contractor shall protect from damage all existing improvements and utilities at or near the work site and on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(FAR 52.236-9)

C. Refer to Section 01568, ENVIRONMENTAL PROTECTION, for additional requirements on protecting vegetation, soils and the environment. Refer

to Articles, "Alterations", "Restoration", and "Operations and Storage Areas" for additional instructions concerning repair of damage to structures and site improvements.

D. Refer to FAR 52.236-7, "Permits and Responsibilities," which is included in General Conditions. A National Pollutant Discharge Elimination System (NPDES) permit is required for this project. The Contractor is considered an "operator" under the permit and has extensive responsibility for compliance with permit requirements. VA will make the permit application available at the (appropriate medical center) office. The apparent low bidder, contractor and affected subcontractors shall furnish all information and certifications that are required to comply with the permit process and permit requirements. Many of the permit requirements will be satisfied by completing construction as shown and specified. Some requirements involve the Contractor's method of operations and operations planning and the Contractor is responsible for employing best management practices. The affected activities often include, but are not limited to the following:
   - Designating areas for equipment maintenance and repair;
   - Providing waste receptacles at convenient locations and provide regular collection of wastes;
   - Locating equipment wash down areas on site, and provide appropriate control of wash-waters;
   - Providing protected storage areas for chemicals, paints, solvents, fertilizers, and other potentially toxic materials; and
   - Providing adequately maintained sanitary facilities.

1.9 RESTORATION

A. Remove, cut, alter, replace, patch and repair existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work, and do not disturb any piping, gas, or mechanical and electric work without approval of the Resident Engineer. Existing work to be altered or extended and that is found to be defective in any way, shall be reported to the Resident Engineer before it is disturbed. Materials and workmanship used in restoring work, shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.

B. Upon completion of contract, deliver work complete and undamaged. Existing work (walls, ceilings, partitions, floors, mechanical and electrical work, lawns, paving, roads, walks, etc.) disturbed or removed as a result of performing required new work, shall be patched, repaired,

reinstalled, or replaced with new work, and refinished and left in as good condition as existed before commencing work.

C. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone) which are indicated on drawings and which are not scheduled for discontinuance or abandonment.

D. Expense of repairs to such utilities and systems not shown on drawings or locations of which are unknown will be covered by adjustment to contract time and price in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) and "DIFFERING SITE CONDITIONS" (FAR 52.236-2) of Section, GENERAL CONDITIONS.

1.10 PHYSICAL DATA

A. Data and information furnished or referred to below is for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(FAR 52.236-4)

B. Subsurface conditions need to be developed by core borings and test pits.

C. Bidders are to include 3 soil borings including soil analysis as part of the bid.

1.11 PROFESSIONAL SURVEYING SERVICES

A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall perform services specified herein and in other specification sections. The Contractor shall certify that the land surveyor or civil engineer is not one who is a regular employee of the Contractor, and that the land surveyor or civil engineer has no financial interest in this contract.

1.12 LAYOUT OF WORK

A. The Contractor shall lay out the work from Government established base lines and bench marks, indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at Contractor's own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or

indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through Contractor's negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due or to become due to the Contractor.

(FAR 52.236-17)

B. Establish and plainly mark center lines for each structure, and such other lines and grades that are reasonably necessary to properly assure that location, orientation, and elevations established for each such structure and or addition, roads, parking lots, are in accordance with lines and elevations shown on contract drawings.

C. Following completion of general mass excavation and before any other permanent work is performed, establish and plainly mark (through use of appropriate batter boards or other means) sufficient additional survey control points or system of points as may be necessary to assure proper alignment, orientation, and grade of all major features of work. Survey shall include, but not be limited to, location of lines and grades of footings, exterior walls, center lines of structures in both directions, major utilities and elevations of paving, floor slabs:

1. Such additional survey control points or system of points thus established shall be checked and certified by a registered land surveyor or registered civil engineer. Furnish such certification to the Resident Engineer before any work (such as footings, floor slabs, columns, slabs, exterior walls, structures, utilities and other major controlling features) is placed.

D. During progress of work, Contractor shall have line grades and plumbness of all major form work checked and certified by a registered land surveyor or registered civil engineer as meeting requirements of contract drawings. Furnish such certification to the Resident Engineer before any major items of concrete work are placed.

In addition, Contractor shall also furnish to the Resident Engineer certificates from a registered land surveyor or registered civil engineer that the following work is complete in every respect as required by contract drawings.

1. Lines of columbarium walls.
2. Elevations of bottoms of footings.
3. Lines and elevations of sub-drain piping and of all outside distribution systems.
4. Lines of elevations of all swales.

5. Lines and elevations of roads, pavings and columbarium walls.

Upon completion of the work, the Contractor shall furnish the Resident Engineer, reproducible drawings at the scale of the contract drawings, showing the finished grade on the grid developed for constructing the work, including burial monuments and fifty foot stationing along new road centerlines. These drawings shall bear the seal of the registered land surveyor or registered civil engineer.

F. The Contractor shall perform the surveying and layout work of this and other articles and specifications in accordance with the provisions of Article "Professional Surveying Services".

1.13 AS-BUILT DRAWINGS

A. The contractor shall maintain two full size sets of as-built drawings which will be kept current during construction of the project, to include all contract changes, modifications and clarifications.

B. All variations shall be shown in the same general detail as used in the contract drawings. To insure compliance, as-built drawings shall be made available for the Resident Engineer's review, as often as requested.

C. Contractor shall deliver two approved completed sets of as-built drawings to the Resident Engineer within 15 calendar days after each completed phase and after the acceptance of the project by the Resident Engineer.

D. Paragraphs A, B, & C shall also apply to all shop drawings.

1.14 USE OF ROADWAYS

A. For hauling, use only established public roads, and roads on Cemetery property and, when authorized by the Resident Engineer, such temporary roads which are necessary in the performance of contract work. Temporary roads shall be constructed by the Contractor at Contractor's expense. When necessary to cross curbing, sidewalks, or similar construction, they must be protected by well-constructed bridges.

1.15 TEMPORARY TOILETS

A. Provide where directed, (for use of all Contractor's workmen) ample temporary sanitary toilet accommodations with suitable sewer and water connections; or, when approved by Resident Engineer, provide suitable dry closets where directed. Keep such places clean and free from flies, and all connections and appliances connected therewith are to be removed prior to completion of contract, and premises left perfectly clean.

1.16 AVAILABILITY AND USE OF UTILITY SERVICES

A. The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. The amount to be paid by the Contractor for chargeable electrical services shall be the prevailing rates charged to

the Government. The Contractor shall carefully conserve any utilities furnished without charge.

B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of electricity used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

C. Contractor shall install meters at Contractor's expense and furnish the Cemetery a monthly record of the Contractor's usage of electricity as hereinafter specified.

D. Heat: Furnish temporary heat necessary to prevent injury to work and materials through dampness and cold. Use of open salamanders or any temporary heating devices which may be fire hazards or may smoke and damage finished work, will not be permitted. Maintain minimum temperatures as specified for various materials:

E. Electricity (for Construction and Testing): Furnish all temporary electric services.

1. Obtain electricity by connecting to the Cemetery electrical distribution system. The Contractor shall meter and pay for electricity required for electric cranes and hoisting devices, electrical welding devices and any electrical heating devices providing temporary heat. Electricity for all other uses is available at no cost to the Contractor.

F. Water (for Construction and Testing): Furnish temporary water service.

1. Obtain water by connecting to the Cemetery water distribution system. Provide reduced pressure backflow preventer at each connection. Water is available at no cost to the Contractor.
2. Maintain connections, pipe, fittings and fixtures and conserve water-use so none is wasted. Failure to stop leakage or other wastes will be cause for revocation (at Resident Engineer's discretion) of use of water from Cemetery's system.

1.17 TESTS

A. Pre-test mechanical and electrical equipment and systems and make corrections required for proper operation of such systems before requesting final tests. Final test will not be conducted unless pre-tested.

B. Conduct final tests required in various sections of specifications in presence of an authorized representative of the Contracting Officer.

Contractor shall furnish all labor, materials, equipment, instruments, and forms, to conduct and record such tests.

C. Mechanical and electrical systems shall be balanced, controlled and coordinated. A system is defined as the entire complex which must be coordinated to work together during normal operation to produce results for which the system is designed. For example, air conditioning supply air is only one part of entire system which provides comfort conditions for a building. All related components shall be functioning when any system component is tested. Tests shall be completed within a reasonably short period of time during which operating and environmental conditions remain reasonably constant.

E. Individual test result of any component, where required, will only be accepted when submitted with the test results of related components and of the entire system.

1.18 INSTRUCTIONS

A. Contractor shall furnish Maintenance and Operating manuals and verbal instructions when required by the various sections of the specifications and as hereinafter specified.

B. Manuals: Maintenance and operating manuals (four copies each) for each separate piece of equipment shall be delivered to the Resident Engineer coincidental with the delivery of the equipment to the job site. Manuals shall be complete, detailed guides for the maintenance and operation of equipment. They shall include complete information necessary for starting, adjusting, maintaining in continuous operation for long periods of time and dismantling and reassembling of the complete units and sub-assembly components. Manuals shall include an index covering all component parts clearly cross-referenced to diagrams and illustrations. Illustrations shall include "exploded" views showing and identifying each separate item. Emphasis shall be placed on the use of special tools and instruments. The function of each piece of equipment, component, accessory and control shall be clearly and thoroughly explained. All necessary precautions for the operation of the equipment and the reason for each precaution shall be clearly set forth. Manuals must reference the exact model, style and size of the piece of equipment and system being furnished. Manuals referencing equipment similar to but of a different model, style, and size than that furnished will not be accepted.

C. Instructions: Contractor shall provide qualified, factory-trained manufacturers' representatives to give detailed instructions to assigned Department of Veterans Affairs personnel in the operation and complete maintenance for each piece of equipment. All such training will be at

the job site. These requirements are more specifically detailed in the various technical sections. Instructions for different items of equipment that are component parts of a complete system, shall be given in an integrated, progressive manner. All instructors for every piece of component equipment in a system shall be available until instructions for all items included in the system have been completed. This is to assure proper instruction in the operation of inter-related systems. All instruction periods shall be at such times as scheduled by the Resident Engineer and shall be considered concluded only when the Resident Engineer is satisfied in regard to complete and thorough coverage. The Department of Veterans Affairs reserves the right to request the removal of, and substitution for, any instructor who, in the opinion of the Resident Engineer, does not demonstrate sufficient qualifications in accordance with requirements for instructors above.

G. Furnish supervision of installation of equipment at construction site by qualified factory trained technicians regularly employed by the equipment manufacturer.

1.19 CONSTRUCTION SIGN

A. Provide a Construction Sign where directed by the Resident Engineer. All wood members shall be of framing lumber. Cover sign frame with 0.7 mm (24 gage) galvanized sheet steel nailed securely around edges and on all bearings. Provide three 100 by 100 mm (4 inch by 4 inch) posts (or equivalent round posts) set 1200 mm (four feet) into ground. Set bottom of sign level at 900 mm (three feet) above ground and secure to posts with through bolts. Make posts full height of sign. Brace posts with 50 x 100 mm (two by four inch) material as directed.

B. Paint all surfaces of sign and posts two coats of white gloss paint. Border and letters shall be of black gloss paint, except project title which shall be blue gloss paint.

C. Maintain sign and remove it when directed by the Resident Engineer.

D. Detail Drawing of construction sign showing required legend and other characteristics of sign is shown on the drawings.

1.20 SAFETY SIGN

A. Provide a Safety Sign where directed by Resident Engineer. Face of sign shall be 19 mm (3/4 inch) thick exterior grade plywood. Provide two 100 mm by 100 mm (four by four inch) posts extending full height of sign and 900 mm (three feet) into ground. Set bottom of sign level at 1200 mm (four feet) above ground.

B. Paint all surfaces of Safety Sign and posts with one prime coat and two coats of white gloss paint. Letters and design shall be painted with gloss paint of colors noted.
C. Maintain sign and remove it when directed by Resident Engineer.
D. Detail Drawing of safety sign showing required legend and other characteristics of sign is shown on the drawings.
E. Post the number of accident free days on a daily basis.

1.21 CONSTRUCTION PHOTOGRAPHS

A. During construction period through completion, furnish Department of Veterans Affairs 100 views of photographs, which include one color print of each view and one Compact Disc (CD) per visit containing those views taken that visit. Photographic views shall be taken of exterior and interior as selected and directed by Resident Engineer. Photographs of reinforcing steel shall be taken after all reinforcing steel, sleeves, inserts, etc. are in place but prior to setting of runways.
   1. Normally such photographs will be taken at monthly intervals. However, the Resident Engineer may also direct taking of special photographs at any time prior to completion and acceptance of contract.
   2. In event a greater or lesser number of photographs than above specified are required by the Resident Engineer, adjustment in contract price will be made in accordance with clause entitled "CHANGES" (FAR 52.243-4 and VAAR 852.236-88) of Section 01001, GENERAL CONDITIONS.
B. Photographs shall be taken by a commercial photographer and must show distinctly, at as large a scale as possible, all parts of work embraced in picture. Prints shall be made on 200 x 250 mm (8 by 10 inch) regular-weight matte paper and produced by an Ektacolor or Kodacolor process:
   1. Photos will be taken with a high-resolution digital camera, minimum 6 megapixels, with good wide-angle capability. The photo files should be 13 – 20 mb uninterpolated digital files.
   2. Photographs shall have 200 x 200 mm (8 by 8 inch) full picture print with no margin on three sides and masking out of negative 50 mm (2 inches) on the bottom for pretyped self-adhesive identity label to be added by Resident Engineer. PHOTO NUMBER shall be included in the digital file name and on the photo print label.
   3. The following format shall be used for the identity-label for photographs:

	PHOTO NO.:_____	CAMP NELSON NATIONAL CEMETERY
CONSTRUCTION COMPANY	DATE TAKEN: _____	Location: CAMP NELSON
Contract No.: _____	Project Title: 750-NICHE COLUMBARIUM	
	Project No.: 833CM025	Resident Engineer

Note: The above information shall be typewritten on a self-adhesive label 200 x 50 mm (eight inches by two inches) and placed on margin at the bottom of each construction photograph.

C. The digital photo files shall become property of Government and must be forwarded on a compact disc with the prints. Prints must be shipped flat to the Resident Engineer.

1. In case any set of prints are not submitted within five days of date established by Resident Engineer for taking thereof, the Resident Engineer shall have such photographs taken and cost of same will be deducted from any money due to the Contractor.

1.22 FINAL ELEVATION PHOTOGRAPHS

A. Identifying data shall be carried on label affixed to back of photograph without damage to photograph and shall be similar to that provided for final construction photographs.

B. Photographs shall be taken upon completion, including landscaping. They shall be taken on a clear sunny day to obtain sufficient detail to show depth and to provide clear, sharp pictures. They shall be 400 mm x 500 mm (16 by 20 inches), on regular weight paper, matte finish, and produced by an Ektacolor or Kodacolor process from not less than 100 by 125 mm (four by five inch) negatives. In addition, provide all final elevation photographs in electronic format on Compact Discs (CD).

C. Furnish one 400 mm x 500 mm (16 by 20 inch) color print of the following buildings constructed under this project. Photographs shall be artistically composed showing full front elevations. A minimum of three views shall be taken and proofs submitted to the Resident Engineer for selection of final photograph. Minimum digital photo file size for final photos is 20 mb uninterpolated, preferably 52 mb.

1.23 INTERIOR COLOR SLIDES

Provide 35 mm positive color transparencies mounted in slides from film exposed to render color of subjects as close as possible to their natural hues and relative color values. Color correct slides to accurately reflect existing conditions. For number and location of views, see Section 09050, INTERIOR/EXTERIOR FINISHES, MATERIALS, AND FINISH SCHEDULE. View shall be taken after final completion of work. In

addition, provide all final interior color slide views in electronic format on Compact discs (CD).

1.24 HISTORIC PRESERVATION

Kentucky SHPO notification of findings of no significant impact or no adverse effect is required. The contractor’s A/E shall notify SHPO of the intent of the project per Kentucky State requirements. The contractor shall prepare notification documents for the COTR’s signature prior to sending to SHPO. Where the Contractor or any of the Contractor's employees, prior to, or during the construction work, are advised of or discover any possible archeological, historical and/or cultural resources, the Contractor shall immediately notify the Resident Engineer verbally, and then with a written follow up.

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SECTION 01 33 23
SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1-1. Refer to Articles titled SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FAR 52.236-21) and, SPECIAL NOTES (VAAR 852.236-91), in Section 00 72 00, GENERAL CONDITIONS.

1-2. For the purposes of this contract, samples (including laboratory samples to be tested), test reports, certificates, and manufacturers' literature and data shall also be subject to the previously referenced requirements. The following text refers to all items collectively as SUBMITTALS.

1-3. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:

A. Satisfactory written evidence is presented to, and approved by Contracting Officer, that manufacturer cannot make scheduled delivery of approved item or;
B. Item delivered has been rejected and substitution of a suitable item is an urgent necessity or;
C. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Government.

1-4. Forward submittals in sufficient time to permit proper consideration and approval action by Government. Time submission to assure adequate lead time for procurement of contract - required items. Delays attributable to untimely and rejected submittals (including any laboratory samples to be tested) will not serve as a basis for extending contract time for completion.

1-5. Submittals will be reviewed for compliance with contract requirements by Architect-Engineer, and action thereon will be taken by COTR on behalf of the Contracting Officer.

1-6. Upon receipt of submittals, Architect-Engineer will assign a file number thereto. Contractor, in any subsequent correspondence, shall refer to this file and identification number to expedite replies relative to previously approved or disapproved submittals.

1-7. The Government reserves the right to require additional submittals, whether or not particularly mentioned in this contract. If additional

submittals beyond those required by the contract are furnished pursuant to request therefor by Contracting Officer, adjustment in contract price and time will be made in accordance with Articles titled CHANGES (FAR 52.243-4) and CHANGES - SUPPLEMENT (VAAR 852.236-88) of the GENERAL CONDITIONS.

1-8. Schedules called for in specifications and shown on shop drawings shall be submitted for use and information of Department of Veterans Affairs and Architect-Engineer. However, the Contractor shall assume responsibility for coordinating and verifying schedules. The Contracting Officer and Architect- Engineer assumes no responsibility for checking schedules or layout drawings for exact sizes, exact numbers and detailed positioning of items.

1-9. Submittals must be submitted by Contractor only and shipped prepaid. Contracting Officer assumes no responsibility for checking quantities or exact numbers included in such submittals.

A. Submit samples in single units unless otherwise specified. Submit shop drawings, schedules, manufacturers' literature and data, and certificates in quadruplicate, except where a greater number is specified.

B. Submittals will receive consideration only when covered by a transmittal letter signed by Contractor. Letter shall be sent via first class mail and shall contain the list of items, name of Cemetery, name of Contractor, contract number, applicable specification paragraph numbers, applicable drawing numbers (and other information required for exact identification of location for each item), manufacturer and brand, ASTM or Federal Specification Number (if any) and such additional information as may be required by specifications for particular item being furnished. In addition, catalogs shall be marked to indicate specific items submitted for approval.

1. A copy of letter must be enclosed with items, and any items received without identification letter will be considered "unclaimed goods" and held for a limited time only.
2. Each sample, certificate, manufacturers' literature and data shall be labeled to indicate the name and location of the Cemetery, name of Contractor, manufacturer, brand, contract number and ASTM or Federal Specification Number as applicable and location(s) on project.
3. Required certificates shall be signed by an authorized representative of manufacturer or supplier of material, and by Contractor.

C. If submittal samples have been disapproved, resubmit new samples as soon as possible after notification of disapproval. Such new samples shall be

marked "Resubmitted Sample" in addition to containing other previously specified information required on label and in transmittal letter.

D. Approved samples will be kept on file by the COTR at the site until completion of contract, at which time such samples will be delivered to Contractor as Contractor's property. Where noted in technical sections of specifications, approved samples in good condition may be used in their proper locations in contract work. At completion of contract, samples that are not approved will be returned to Contractor only upon request and at Contractor's expense. Such request should be made prior to completion of the contract. Disapproved samples that are not requested for return by Contractor will be discarded after completion of contract.

E. Submittal drawings (shop, erection or setting drawings) and schedules, required for work of various trades, shall be checked before submission by technically qualified employees of Contractor for accuracy, completeness and compliance with contract requirements. These drawings and schedules shall be stamped and signed by Contractor certifying to such check.

1. For each drawing required, submit one legible photographic paper or vellum reproducible.
2. Reproducible shall be full size.
3. Each drawing shall have marked thereon, proper descriptive title, including Cemetery location, project number, manufacturer's number, reference to contract drawing number, detail Section Number, and Specification Section Number.
4. A space 120 mm by 125 mm (4-3/4 by 5 inches) shall be reserved on each drawing to accommodate approval or disapproval stamp.
5. Submit drawings, ROLLED WITHIN A MAILING TUBE, fully protected for shipment.
6. One reproducible print of approved or disapproved shop drawings will be forwarded to Contractor.
7. When work is directly related and involves more than one trade, shop drawings shall be submitted to Architect-Engineer under one cover.

1-10. Samples, shop drawings, test reports, certificates and manufacturers' literature and data, shall be submitted for approval to

_____

(Architect-Engineer)

_____

(A/E P.O. Address)

_____

(City, State and Zip Code)

1-11. At the time of transmittal to the Architect-Engineer, the Contractor shall also send a copy of the complete submittal directly to the COTR.

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies the availability and source of references and standards specified in the project manual under paragraphs APPLICABLE PUBLICATIONS and/or shown on the drawings.

1.2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS FPMR PART 101-29 (FAR 52.211-1) (AUG 1998)

A. The GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29 and copies of specifications, standards, and commercial item descriptions cited in the solicitation may be obtained for a fee by submitting a request to – GSA Federal Supply Service, Specifications Section, Suite 8100, 470 East L'Enfant Plaza, SW, Washington, DC 20407, Telephone (202) 619-8925, Facsimile (202) 619-8978.

B. If the General Services Administration, Department of Agriculture, or Department of Veterans Affairs issued this solicitation, a single copy of specifications, standards, and commercial item descriptions cited in this solicitation may be obtained free of charge by submitting a request to the addressee in paragraph (a) of this provision. Additional copies will be issued for a fee.

1.3 AVAILABILITY FOR EXAMINATION OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-4) (JUN 1988)

The specifications and standards cited in this solicitation can be examined at the following location:

DEPARMENT OF VETERANS AFFAIRS
Office of Construction & Facilities Management
Facilities Quality Service (00CFM1A)
811 Vermont Avenue, NW - Room 462
Washington, DC 20420
Telephone Number: (202) 565-5214
Between 9:00 AM - 3:00 PM

1.4 AVAILABILITY OF SPECIFICATIONS NOT LISTED IN THE GSA INDEX OF FEDERAL SPECIFICATIONS, STANDARDS AND COMMERCIAL ITEM DESCRIPTIONS (FAR 52.211-3) (JUN 1988)

The specifications cited in this solicitation may be obtained from the associations or organizations listed below.

AA Aluminum Association Inc.
http://www.aluminum.org

AABC	Associated Air Balance Council http://www.aabchq.com
AAMA	American Architectural Manufacturer's Association http://www.aamanet.org
AAN	American Nursery and Landscape Association http://www.anla.org
AASHTO	American Association of State Highway and Transportation Officials http://www.aashto.org
AATCC	American Association of Textile Chemists and Colorists http://www.aatcc.org
ACGIH	American Conference of Governmental Industrial Hygienists http://www.acgih.org
ACI	American Concrete Institute http://www.aci-int.net
ACPA	American Concrete Pipe Association http://www.concrete-pipe.org
ACPPA	American Concrete Pressure Pipe Association http://www.acppa.org
ADC	Air Diffusion Council http://flexibleduct.org
AGA	American Gas Association http://www.aga.org
AGC	Associated General Contractors of America http://www.agc.org
AGMA	American Gear Manufacturers Association, Inc. http://www.agma.org
AHAM	Association of Home Appliance Manufacturers http://www.aham.org
AISC	American Institute of Steel Construction http://www.aisc.org
AISI	American Iron and Steel Institute http://www.steel.org
AITC	American Institute of Timber Construction http://www.aitc-glulam.org
AMCA	Air Movement and Control Association, Inc. http://www.amca.org
ANLA	American Nursery & Landscape Association http://www.anla.org
ANSI	American National Standards Institute, Inc. http://www.ansi.org
APA	The Engineered Wood Association

	http://www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute http://www.ari.org
ASAE	American Society of Agricultural Engineers http://www.asae.org
ASCE	American Society of Civil Engineers http://www.asce.org
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers http://www.ashrae.org
ASME	American Society of Mechanical Engineers http://www.asme.org
ASSE	American Society of Sanitary Engineering http://www.asse-plumbing.org
ASTM	American Society for Testing and Materials http://www.astm.org
AWI	Architectural Woodwork Institute http://www.awinet.org
AWS	American Welding Society http://www.aws.org
AWWA	American Water Works Association http://www.awwa.org
BHMA	Builders Hardware Manufacturers Association http://www.buildershardware.com
BIA	Brick Institute of America http://www.bia.org
CAGI	Compressed Air and Gas Institute http://www.cagi.org
CGA	Compressed Gas Association, Inc. http://www.cganet.com
CI	The Chlorine Institute, Inc. http://www.chlorineinstitute.org
CISCA	Ceilings and Interior Systems Construction Association http://www.cisca.org
CISPI	Cast Iron Soil Pipe Institute http://www.cispi.org
CLFMI	Chain Link Fence Manufacturers Institute http://www.chainlinkinfo.org
CPMB	Concrete Plant Manufacturers Bureau http://www.cpmb.org
CRA	California Redwood Association

	http://www.calredwood.org
CRSI	Concrete Reinforcing Steel Institute
	http://www.crsi.org
CTI	Cooling Technology Institute
	http://www.cti.org
DHI	Door and Hardware Institute
	http://www.dhi.org
EGSA	Electrical Generating Systems Association
	http://www.egsa.org
EEI	Edison Electric Institute
	http://www.eei.org
EPA	Environmental Protection Agency
	http://www.epa.gov
ETL	ETL Testing Laboratories, Inc.
	http://www.et1.com
FAA	Federal Aviation Administration
	http://www.faa.gov
FCC	Federal Communications Commission
	http://www.fcc.gov
FPS	The Forest Products Society
	http://www.forestprod.org
GANA	Glass Association of North America
	http://www.cssinfo.com/info/gana.html/
FM	Factory Mutual Insurance
	http://www.fmglobal.com
GA	Gypsum Association
	http://www.gypsum.org
GSA	General Services Administration
	http://www.gsa.gov
HI	Hydraulic Institute
	http://www.pumps.org
HPVA	Hardwood Plywood & Veneer Association
	http://www.hpva.org
ICBO	International Conference of Building Officials
	http://www.icbo.org
ICEA	Insulated Cable Engineers Association Inc.
	http://www.icea.net
\ICAC	Institute of Clean Air Companies
	http://www.icac.com
IEEE	Institute of Electrical and Electronics Engineers
	http://www.ieee.org\

IMSA International Municipal Signal Association
http://www.imsasafety.org

IPCEA Insulated Power Cable Engineers Association

NBMA Metal Buildings Manufacturers Association
http://www.mbma.com

MSS Manufacturers Standardization Society of the Valve and Fittings Industry Inc.
http://www.mss-hq.com

NAAMM National Association of Architectural Metal Manufacturers
http://www.naamm.org

NAPHCC Plumbing-Heating-Cooling Contractors Association
http://www.phccweb.org.org

NBS National Bureau of Standards
See - NIST

NBBPVI National Board of Boiler and Pressure Vessel Inspectors
http://www.nationboard.org

NEC National Electric Code
See - NFPA National Fire Protection Association

NEMA National Electrical Manufacturers Association
http://www.nema.org

NFPA National Fire Protection Association
http://www.nfpa.org

NHLA National Hardwood Lumber Association
http://www.natlhardwood.org

NIH National Institute of Health
http://www.nih.gov

NIST National Institute of Standards and Technology
http://www.nist.gov

NLMA Northeastern Lumber Manufacturers Association, Inc.
http://www.nelma.org

NPA National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879
(301) 670-0604

NSF National Sanitation Foundation
http://www.nsf.org

NWWDA Window and Door Manufacturers Association
http://www.nwwda.org

OSHA Occupational Safety and Health Administration
Department of Labor
http://www.osha.gov

PCA	Portland Cement Association http://www.portcement.org
PCI	Precast Prestressed Concrete Institute http://www.pci.org
PPI	The Plastic Pipe Institute http://www.plasticpipe.org
PEI	Porcelain Enamel Institute, Inc. http://www.porcelainenamel.com
PTI	Post-Tensioning Institute http://www.post-tensioning.org
RFCI	The Resilient Floor Covering Institute http://www.rfci.com
RIS	Redwood Inspection Service See - CRA
RMA	Rubber Manufacturers Association, Inc. http://www.rma.org
SCMA	Southern Cypress Manufacturers Association http://www.cypressinfo.org
SDI	Steel Door Institute http://www.steeldoor.org
IGMA	Insulating Glass Manufacturers Alliance http://www.igmaonline.org
SJI	Steel Joist Institute http://www.steeljoist.org
SMACNA	Sheet Metal and Air-Conditioning Contractors National Association, Inc. http://www.smacna.org
SSPC	The Society for Protective Coatings http://www.sspc.org
STI	Steel Tank Institute http://www.steeltank.com
SWI	Steel Window Institute http://www.steelwindows.com
TCA	Tile Council of America, Inc. http://www.tileusa.com
TEMA	Tubular Exchange Manufacturers Association http://www.tema.org
TPI	Truss Plate Institute, Inc. 583 D'Onofrio Drive; Suite 200 Madison, WI 53719 (608) 833-5900

UBC	The Uniform Building Code See ICBO
UL	Underwriters' Laboratories Incorporated http://www.ul.com
ULC	Underwriters' Laboratories of Canada http://www.ulc.ca
WCLIB	West Coast Lumber Inspection Bureau 6980 SW Varns Road, P.O. Box 23145 Portland, OR 97223 (503) 639-0651
WRCLA	Western Red Cedar Lumber Association P.O. Box 120786 New Brighton, MN 55112 (612) 633-4334
WWPA	Western Wood Products Association http://www.wwpa.org

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-06.....Sieve Analysis of Fine and Coarse Aggregates

T96-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop

T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

T180-01 (R2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

T191-02(R2006).....Density of Soil In-Place by the Sand-Cone Method

C. American Concrete Institute (ACI):

506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete

D. American Society for Testing and Materials (ASTM):

A325-06.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A370-07.....Definitions for Mechanical Testing of Steel Products

A416/A416M-06.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A490-06.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

C31/C31M-06.....Making and Curing Concrete Test Specimens in the Field

C33-03.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-05.....Compressive Strength of Hydraulic Cement Mortars
C138-07.....Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-07.....Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-05.....Slump of Hydraulic Cement Concrete
C172-07.....Sampling Freshly Mixed Concrete
C173-07.....Air Content of freshly Mixed Concrete by the Volumetric Method
C330-05.....Lightweight Aggregates for Structural Concrete
C567-05.....Density Structural Lightweight Concrete
C780-07.....Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-08.....Sampling and Testing Grout
C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete
C1077-06.....Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-07.....Compressive Strength of Masonry Prisms
D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143-07.....Piles Under Static Axial Compressive Load
D1188-07.....Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07.....Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06.....Unconfined Compressive Strength of Cohesive Soil
D2167-94(R2001).....Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-05.....Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2922-05.....Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D2974-07.....Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3666-(2002).....Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-07.....Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material
E94-04.....Radiographic Testing
E164-03.....Ultrasonic Contact Examination of Weldments
E329-07.....Agencies Engaged in Construction Inspection and/or Testing
E543-06.....Agencies Performing Non-Destructive Testing
E605-93(R2006).....Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
E709-(2001).....Guide for Magnetic Particle Examination
E1155-96(R2008).....Determining FF Floor Flatness and FL Floor Levelness Numbers

E. American Welding Society (AWS):
D1.1-07.....Structural Welding Code-Steel

1.3 REQUIREMENTS:

A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor, must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the COTR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the COTR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D3740.
5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.

6. Laboratories engaged in non-destructive testing (NDT) shall meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COTR to such failure.

C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to COTR immediately of any irregularity.

E. Test Standards: The Contractor shall include a lump sum allowance of $5000 for furnishing published standards (ASTM, AASHTO, ACI, ANSI, AWS, ASHRAE, UL, etc.) referred to or specifically referenced which are pertinent to any Sections of these specifications. Furnish one set of standards in single copies or bound volumes to the COTR within 60 days. Photocopies are not acceptable. Billings for the standards furnished shall be at the net cost to Testing Laboratory. A preliminary list of test standards, with the estimated costs, shall be submitted to the COTR for review before any publications of reference standards are ordered.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with // AASHTO // T99/T180 // Method A // // ASTM // D698 // D1557 // Method A // ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D2922 // AASHTO T238 // wherever possible. Field density tests utilizing ASTM D1556 // AASHTO T191 //, or // ASTM D2167 // shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COTR before the tests are conducted.

    a. Building Slab Subgrade: At least one test of subgrade for every 185 m^2 (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m^2 (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
    b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
    c. Pavement Subgrade: One test for each 335 m^2 (400 square yards), but in no case fewer than two tests.
    d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
    e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
    f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to COTR. In each compacted fill layer below wall

footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.

C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

D. Testing Materials: Test suitability of on-site and off-site borrow as directed by COTR.

3.2 FOUNDATION PILES:

A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.

B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to COTR.

3.3 FOUNDATION CAISSONS:

A. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's placement of concrete.

B. Maintain a record of concrete used in each caisson. Compare records with calculated volumes.

C. Inspect percussion hole in bottom of each caisson to determine that material is capable of supporting design load.

D. Inspect sides and bottom of each caisson for compliance with contract documents.

E. Submit a certified “Caisson Field Record” for each caisson, recording actual elevation at bottom of shaft; final center line location of top; variation of shaft from plumb; results of all tests performed; actual allowable bearing capacity of bottom; depth of socket into rock; levelness of bottom; seepage of water; still water level (if allowed to flood); variation of shaft (from dimensions shown); location and size of reinforcement, and evidence of seams, voids, or channels below the bottom. Verify the actual bearing capacity of the rock strata by the use of a calibrated penetrometer or other acceptable method.

F. Caissons Bearing on Hardpan: Take undisturbed samples, suitable for tests required, from caisson bottom. Make auger probe to a depth of 2.5 meters (8 feet) below bottom and visually inspect and classify soil. Verify continuity of strata and thickness.

1. Conduct the following test on each sample, and report results and evaluations to the COTR:
   a. Unconfined Compression Test (ASTM D2166).
   b. Moisture Content (ASTM D2216).
   c. Density.

3.4 LANDSCAPING:

A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
   1. Test for organic material by using ASTM D2974.
   2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.

B. Submit laboratory test report of topsoil to COTR.

3.5 SITE WORK CONCRETE:

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.6 CONCRETE:

A. Batch Plant Inspection and Materials Testing:
   1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by COTR.
   2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COTR.
   3. Sample and test mix ingredients as necessary to insure compliance with specifications.
   4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
   5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:
   1. Provide a technician at site of placement at all times to perform concrete sampling and testing.

2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. // After good concrete quality control has been established and maintained as determined by COTR make three cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. // Label each cylinder with an identification number. COTR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:

a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.

11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the COTR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:

a. Grouting under base plates.

b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COTR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COTR. In test report, indicate the following information:
   a. Cylinder identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Type of concrete, slump, and percent air.
   d. Compressive strength of concrete in MPa (psi).
   e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
   f. Weather conditions during placing.
   g. Temperature of concrete in each test cylinder when test cylinder was molded.
   h. Maximum and minimum ambient temperature during placing.
   i. Ambient temperature when concrete sample in test cylinder was taken.
   j. Date delivered to laboratory and date tested.

3.7 REINFORCEMENT:

A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).

B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.8 SHOTCRETE:

A. Inspection and Material Testing:

1. Provide field inspection and testing service as required by COTR to certify that shotcrete has been applied in accordance with contract documents.
2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to COTR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to COTR.
5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.
6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

B. Shotcrete Sampling:
1. Provide a technician at site of placement to perform shotcrete sampling.
2. Take cores in accordance with ACI 506.
3. Insure maintenance of water-cement ratio established by approved trial mix.
4. Verify specified mixing has been accomplished.

C. Laboratory Tests of Field Sample Panels:
1. Compression test core for strength in accordance with ACI 506. For each test series of three cores, test one core at 7 days and one core at 28 days. Use remaining core as a spare to be tested at either 7 or 28 days as required. Compile laboratory test reports as follows: Compressive strength test shall be result of one core, except when one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of spare core shall be used.
2. Submit certified compression test reports (duplicate) to COTR. On test report, indicate following information:
   a. Core identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Compressive strength of shotcrete in MPa (psi).
   d. Weather conditions during placing.
   e. Temperature of shotcrete in each test core when test core was taken.
   f. Maximum and minimum ambient temperature during placing.
   g. Ambient temperature when shotcrete sample was taken.
   h. Date delivered to laboratory and date tested.

D. Submit inspection reports certification and instances of noncompliance to COTR.

3.9 ARCHITECTURAL PRECAST CONCRETE:

A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.

B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

C. Inspect members to insure specification requirements for curing and finishes have been met.

3.10 MASONRY:

A. Mortar Tests:

1. Laboratory compressive strength test:
   a. Comply with ASTM C780.
   b. Obtain samples during or immediately after discharge from batch mixer.
   c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
   d. Test one sample at 7 days and 2 samples at 28 days.
2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

1. Laboratory compressive strength test:
   a. Comply with ASTM C1019.
   b. Test one sample at 7 days and 2 samples at 28 days.
   c. Perform test for each 230 m^2 (2500 square feet) of masonry.

C. Masonry Unit Tests:

1. Laboratory Compressive Strength Test:
   a. Comply with ASTM C140.
   b. Test 3 samples for each 460 m^2 (5000 square feet) of wall area.

D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m^2 (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.11 STRUCTURAL STEEL:

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

1. Review design and shop detail drawings for size, length, type and location of all welds to be made.

2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
3. Approve welder qualifications by certification or retesting.
4. Approve procedure for control of distortion and shrinkage stresses.
5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:
1. Weld Inspection:
   a. Inspect welding equipment for capacity, maintenance and working condition.
   b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
   c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
   d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
   e. Measure 25 percent of fillet welds.
   f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
      1) 20 percent of all shear plate fillet welds at random, final pass only.
      2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
      3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
      4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
      5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
   g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
   i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
   j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:

a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COTR.

3.12 TYPE OF TEST:

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
//(AASHTO T180)//(AASHTO T99)//(ASTM D1557)//(ASTM D698)//	_____
Field Density, Soils (AASHTO T191, T205, or T238)	_____
Penetration Test, Soils	_____
B. Landscaping:	
Topsoil Test	_____

C. Aggregate Base:

Laboratory Compaction, // (AASHTO T180)// //(ASTM D1557)// _____

Field Density,//(AASHTO T191)// //(ASTM D1556)// _____

Aggregate, Base Course

Gradation (AASHTO T27) _____

Wear (AASHTO T96) _____

Soundness (AASHTO T104) _____

D. Asphalt Concrete:

Field Density, (AASHTO T230)//ASTM D1188// _____

Aggregate, Asphalt Concrete

Gradation (AASHTO T27) _____

Wear (AASHTO T96) _____

Soundness (AASHTO T104) _____

E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31) _____

Compressive Strength, Test Cylinders (ASTM C39) _____

Concrete Slump Test (ASTM C143) _____

Concrete Air Content Test (ASTM C173) _____

Unit Weight, Lightweight Concrete (ASTM C567) _____

Aggregate, Normal Weight:

Gradation (ASTM C33) _____

Deleterious Substances (ASTM C33) _____

Soundness (ASTM C33) _____

Abrasion (ASTM C33) _____

Aggregate, Lightweight

Gradation (ASTM C330) _____

Deleterious Substances (ASTM C330) _____

Unit Weight (ASTM C330) _____

Flatness and Levelness Readings (ASTM E1155) (number of days) _____

F. Reinforcing Steel:

Tensile Test (ASTM A370) _____

Bend Test (ASTM A370) _____

Mechanical Splice (ASTM A370) _____

Welded Splice Test (ASTM A370) _____

G. Shotcrete:

Taking and Curing Test Cores (ACI 506) _____
Compressive Strength, Test Cores (ACI 506) _____

H. Prestressed Concrete:
Testing Strands (ASTM A416) _____

I. Masonry:
Making and Curing Test Cubes (ASTM C109) _____
Compressive Strength, Test Cubes (ASTM C109) _____
Sampling and Testing Mortar, Comp. Strength (ASTM C780) _____
Sampling and Testing Grout, Comp. Strength (ASTM C1019) _____
Masonry Unit, Compressive Strength (ASTM C140) _____
Prism Tests (ASTM C1314) _____

J. Structural Steel:
Ultrasonic Testing of Welds (ASTM E164) _____
Magnetic Particle Testing of Welds (ASTM E709) _____
Radiographic Testing of Welds (ASTM E94) _____

L. Inspection:
Technical Personnel (Man-days) _____//

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SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies materials testing activities and inspection services required during project construction to be provided by a Testing Laboratory retained and paid for by Contractor.

1.2 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T27-06.....Sieve Analysis of Fine and Coarse Aggregates

T96-02 (R2006).....Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

T99-01 (R2004).....The Moisture-Density Relations of Soils Using a 2.5 Kg (5.5 lb.) Rammer and a 305 mm (12 in.) Drop

T104-99 (R2003).....Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

T180-01 (R2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

T191-02(R2006).....Density of Soil In-Place by the Sand-Cone Method

C. American Concrete Institute (ACI):

506.4R-94 (R2004).....Guide for the Evaluation of Shotcrete

D. American Society for Testing and Materials (ASTM):

A325-06.....Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A370-07.....Definitions for Mechanical Testing of Steel Products

A416/A416M-06.....Steel Strand, Uncoated Seven-Wire for Prestressed Concrete

A490-06.....Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength

C31/C31M-06.....Making and Curing Concrete Test Specimens in the Field

C33-03.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens
C109/C109M-05.....Compressive Strength of Hydraulic Cement Mortars
C138-07.....Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C140-07.....Sampling and Testing Concrete Masonry Units and Related Units
C143/C143M-05.....Slump of Hydraulic Cement Concrete
C172-07.....Sampling Freshly Mixed Concrete
C173-07.....Air Content of freshly Mixed Concrete by the Volumetric Method
C330-05.....Lightweight Aggregates for Structural Concrete
C567-05.....Density Structural Lightweight Concrete
C780-07.....Pre-construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C1019-08.....Sampling and Testing Grout
C1064/C1064M-05.....Freshly Mixed Portland Cement Concrete
C1077-06.....Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
C1314-07.....Compressive Strength of Masonry Prisms
D698-07.....Laboratory Compaction Characteristics of Soil Using Standard Effort
D1143-07.....Piles Under Static Axial Compressive Load
D1188-07.....Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
D1556-07.....Density and Unit Weight of Soil in Place by the Sand-Cone Method
D1557-07.....Laboratory Compaction Characteristics of Soil Using Modified Effort
D2166-06.....Unconfined Compressive Strength of Cohesive Soil
D2167-94(R2001).....Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2216-05.....Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2922-05.....Density of soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D2974-07.....Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

D3666-(2002).....Minimum Requirements for Agencies Testing and Inspection Bituminous Paving Materials
D3740-07.....Minimum Requirements for Agencies Engaged in the Testing and Inspecting Road and Paving Material
E94-04.....Radiographic Testing
E164-03.....Ultrasonic Contact Examination of Weldments
E329-07.....Agencies Engaged in Construction Inspection and/or Testing
E543-06.....Agencies Performing Non-Destructive Testing
E605-93(R2006).....Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
E709-(2001).....Guide for Magnetic Particle Examination
E1155-96(R2008).....Determining FF Floor Flatness and FL Floor Levelness Numbers

E. American Welding Society (AWS):
D1.1-07.....Structural Welding Code-Steel

1.3 REQUIREMENTS:

A. Accreditation Requirements: Testing Laboratory retained and paid for by Contractor, must be accredited by one or more of the National Voluntary Laboratory Accreditation Program (NVLAP) programs acceptable in the geographic region for the project. Furnish to the COTR a copy of the Certificate of Accreditation and Scope of Accreditation. For testing laboratories that have not yet obtained accreditation by a NVLAP program, submit an acknowledgement letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the COTR for approval, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

1. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.
2. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.
3. Laboratories engaged in testing of bituminous paving materials shall meet the requirements of ASTM D3666.
4. Laboratories engaged in testing of soil and rock, as used in engineering design and construction, shall meet the requirements of ASTM D3740.
5. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.

6. Laboratories engaged in non-destructive testing (NDT) shall meet the requirements of ASTM E543.
7. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA.

B. Inspection and Testing: Testing laboratory shall inspect materials and workmanship and perform tests described herein and additional tests requested by COTR. When it appears materials furnished, or work performed by Contractor fail to meet construction contract requirements, Testing Laboratory shall direct attention of COTR to such failure.

C. Written Reports: Testing laboratory shall submit test reports to COTR, Contractor, and Local Building Authority within 24 hours after each test is completed unless other arrangements are agreed to in writing by the COTR. Submit reports of tests that fail to meet construction contract requirements on colored paper.

D. Verbal Reports: Give verbal notification to COTR immediately of any irregularity.

E. Test Standards: The Contractor shall include a lump sum allowance of $5000 for furnishing published standards (ASTM, AASHTO, ACI, ANSI, AWS, ASHRAE, UL, etc.) referred to or specifically referenced which are pertinent to any Sections of these specifications. Furnish one set of standards in single copies or bound volumes to the COTR within 60 days. Photocopies are not acceptable. Billings for the standards furnished shall be at the net cost to Testing Laboratory. A preliminary list of test standards, with the estimated costs, shall be submitted to the COTR for review before any publications of reference standards are ordered.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EARTHWORK:

A. General: The Testing Laboratory shall provide qualified personnel, materials, equipment, and transportation as required to perform the services identified/required herein, within the agreed to schedule and/or time frame. The work to be performed shall be as identified herein and shall include but not be limited to the following:

1. Observe fill and subgrades during proof-rolling to evaluate suitability of surface material to receive fill or base course. Provide recommendations to the COTR regarding suitability or unsuitability of areas where proof-rolling was observed. Where unsuitable results are observed, witness excavation of unsuitable material and recommend to COTR extent of removal and replacement of unsuitable materials and observe proof-rolling of replaced areas until satisfactory results are obtained.

2. Provide full time observation of fill placement and compaction and field density testing in building areas and provide full time observation of fill placement and compaction and field density testing in pavement areas to verify that earthwork compaction obtained is in accordance with contract documents.
3. Provide supervised geotechnical technician to inspect excavation, subsurface preparation, and backfill for structural fill.

B. Testing Compaction:

1. Determine maximum density and optimum moisture content for each type of fill, backfill and subgrade material used, in compliance with // AASHTO // T99/T180 // Method A // // ASTM // D698 // D1557 // Method A // ASTM D698 and/or ASTM D1557.
2. Make field density tests in accordance with the primary testing method following ASTM D2922 // AASHTO T238 // wherever possible. Field density tests utilizing ASTM D1556 // AASHTO T191 //, or // ASTM D2167 // shall be utilized on a case by case basis only if there are problems with the validity of the results from the primary method due to specific site field conditions. Should the testing laboratory propose these alternative methods, they should provide satisfactory explanation to the COTR before the tests are conducted.

    a. Building Slab Subgrade: At least one test of subgrade for every 185 m^2 (2000 square feet) of building slab, but in no case fewer than three tests. In each compacted fill layer, perform one test for every 185 m^2 (2000 square feet) of overlaying building slab, but in no case fewer than three tests.
    b. Foundation Wall Backfill: One test per 30 m (100 feet) of each layer of compacted fill but in no case fewer than two tests.
    c. Pavement Subgrade: One test for each 335 m^2 (400 square yards), but in no case fewer than two tests.
    d. Curb, Gutter, and Sidewalk: One test for each 90 m (300 feet), but in no case fewer than two tests.
    e. Trenches: One test at maximum 30 m (100 foot) intervals per 1200 mm (4 foot) of vertical lift and at changes in required density, but in no case fewer than two tests.
    f. Footing Subgrade: At least one test for each layer of soil on which footings will be placed. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested subgrade when acceptable to COTR. In each compacted fill layer below wall

footings, perform one field density test for every 30 m (100 feet) of wall. Verify subgrade is level, all loose or disturbed soils have been removed, and correlate actual soil conditions observed with those indicated by test borings.

C. Testing for Footing Bearing Capacity: Evaluate if suitable bearing capacity material is encountered in footing subgrade.

D. Testing Materials: Test suitability of on-site and off-site borrow as directed by COTR.

3.2 FOUNDATION PILES:

A. Witness load test procedure for conformance with ASTM D1143 and interpret test data to verify geotechnical recommendations for pile capacity. Submit load test report in accordance with ASTM D1143.

B. Review Contractor's equipment, methods, and procedures prior to starting any work on site. Provide continuous inspection of pile installation. Maintain a record of all pertinent phases of operation for submittal to COTR.

3.3 FOUNDATION CAISSONS:

A. Concrete Testing: Test concrete including materials for concrete as required in Article, CONCRETE of this section, except make two test cylinders for each day's placement of concrete.

B. Maintain a record of concrete used in each caisson. Compare records with calculated volumes.

C. Inspect percussion hole in bottom of each caisson to determine that material is capable of supporting design load.

D. Inspect sides and bottom of each caisson for compliance with contract documents.

E. Submit a certified “Caisson Field Record” for each caisson, recording actual elevation at bottom of shaft; final center line location of top; variation of shaft from plumb; results of all tests performed; actual allowable bearing capacity of bottom; depth of socket into rock; levelness of bottom; seepage of water; still water level (if allowed to flood); variation of shaft (from dimensions shown); location and size of reinforcement, and evidence of seams, voids, or channels below the bottom. Verify the actual bearing capacity of the rock strata by the use of a calibrated penetrometer or other acceptable method.

F. Caissons Bearing on Hardpan: Take undisturbed samples, suitable for tests required, from caisson bottom. Make auger probe to a depth of 2.5 meters (8 feet) below bottom and visually inspect and classify soil. Verify continuity of strata and thickness.

1. Conduct the following test on each sample, and report results and evaluations to the COTR:
   a. Unconfined Compression Test (ASTM D2166).
   b. Moisture Content (ASTM D2216).
   c. Density.

3.4 LANDSCAPING:

A. Test topsoil for organic materials, pH, phosphate, potash content, and gradation of particles.
   1. Test for organic material by using ASTM D2974.
   2. Determine percent of silt, sand, clay, and foreign materials such as rock, roots, and vegetation.

B. Submit laboratory test report of topsoil to COTR.

3.5 SITE WORK CONCRETE:

Test site work concrete including materials for concrete as required in Article CONCRETE of this section.

3.6 CONCRETE:

A. Batch Plant Inspection and Materials Testing:
   1. Perform continuous batch plant inspection until concrete quality is established to satisfaction of COTR with concurrence of Contracting Officer and perform periodic inspections thereafter as determined by COTR.
   2. Periodically inspect and test batch proportioning equipment for accuracy and report deficiencies to COTR.
   3. Sample and test mix ingredients as necessary to insure compliance with specifications.
   4. Sample and test aggregates daily and as necessary for moisture content. Test the dry rodded weight of the coarse aggregate whenever a sieve analysis is made, and when it appears there has been a change in the aggregate.
   5. Certify, in duplicate, ingredients and proportions and amounts of ingredients in concrete conform to approved trial mixes. When concrete is batched or mixed off immediate building site, certify (by signing, initialing or stamping thereon) on delivery slips (duplicate) that ingredients in truck-load mixes conform to proportions of aggregate weight, cement factor, and water-cement ratio of approved trial mixes.

B. Field Inspection and Materials Testing:
   1. Provide a technician at site of placement at all times to perform concrete sampling and testing.

2. Review the delivery tickets of the ready-mix concrete trucks arriving on-site. Notify the Contractor if the concrete cannot be placed within the specified time limits or if the type of concrete delivered is incorrect. Reject any loads that do not comply with the Specification requirements. Rejected loads are to be removed from the site at the Contractor’s expense. Any rejected concrete that is placed will be subject to removal.
3. Take concrete samples at point of placement in accordance with ASTM C172. Mold and cure compression test cylinders in accordance with ASTM C31. Make at least three cylinders for each 40 m^3 (50 cubic yards) or less of each concrete type, and at least three cylinders for any one day's pour for each concrete type. // After good concrete quality control has been established and maintained as determined by COTR make three cylinders for each 80 m^3 (100 cubic yards) or less of each concrete type, and at least three cylinders from any one day's pour for each concrete type. // Label each cylinder with an identification number. COTR may require additional cylinders to be molded and cured under job conditions.
4. Perform slump tests in accordance with ASTM C143. Test the first truck each day, and every time test cylinders are made. Test pumped concrete at the hopper and at the discharge end of the hose at the beginning of each day’s pumping operations to determine change in slump.
5. Determine the air content of concrete per ASTM C173. For concrete required to be air-entrained, test the first truck and every 20 m^3 (25 cubic yards) thereafter each day. For concrete not required to be air-entrained, test every 80 m^3 (100 cubic yards) at random. For pumped concrete, initially test concrete at both the hopper and the discharge end of the hose to determine change in air content.
6. If slump or air content fall outside specified limits, make another test immediately from another portion of same batch.
7. Perform unit weight tests in compliance with ASTM C138 for normal weight concrete and ASTM C567 for lightweight concrete. Test the first truck and each time cylinders are made.
8. Notify laboratory technician at batch plant of mix irregularities and request materials and proportioning check.
9. Verify that specified mixing has been accomplished.
10. Environmental Conditions: Determine the temperature per ASTM C1064 for each truckload of concrete during hot weather and cold weather concreting operations:

a. When ambient air temperature falls below 4.4 degrees C (40 degrees F), record maximum and minimum air temperatures in each 24 hour period; record air temperature inside protective enclosure; record minimum temperature of surface of hardened concrete.
b. When ambient air temperature rises above 29.4 degrees C (85 degrees F), record maximum and minimum air temperature in each 24 hour period; record minimum relative humidity; record maximum wind velocity; record maximum temperature of surface of hardened concrete.

11. Inspect the reinforcing steel placement, including bar size, bar spacing, top and bottom concrete cover, proper tie into the chairs, and grade of steel prior to concrete placement. Submit detailed report of observations.
12. Observe conveying, placement, and consolidation of concrete for conformance to specifications.
13. Observe condition of formed surfaces upon removal of formwork prior to repair of surface defects and observe repair of surface defects.
14. Observe curing procedures for conformance with specifications, record dates of concrete placement, start of preliminary curing, start of final curing, end of curing period.
15. Observe preparations for placement of concrete:
    a. Inspect handling, conveying, and placing equipment, inspect vibrating and compaction equipment.
    b. Inspect preparation of construction, expansion, and isolation joints.
16. Observe preparations for protection from hot weather, cold weather, sun, and rain, and preparations for curing.
17. Observe concrete mixing:
    a. Monitor and record amount of water added at project site.
    b. Observe minimum and maximum mixing times.
18. Measure concrete flatwork for levelness and flatness as follows:
    a. Perform Floor Tolerance Measurements F_F and F_L in accordance with ASTM E1155. Calculate the actual overall F- numbers using the inferior/superior area method.
    b. Perform all floor tolerance measurements within 48 hours after slab installation and prior to removal of shoring and formwork.
    c. Provide the Contractor and the COTR with the results of all profile tests, including a running tabulation of the overall F_F and F_L values for all slabs installed to date, within 72 hours after each slab installation.
19. Other inspections:

a. Grouting under base plates.

b. Grouting anchor bolts and reinforcing steel in hardened concrete.

C. Laboratory Tests of Field Samples:

1. Test compression test cylinders for strength in accordance with ASTM C39. For each test series, test one cylinder at 7 days and one cylinder at 28 days. Use remaining cylinder as a spare tested as directed by COTR. Compile laboratory test reports as follows: Compressive strength test shall be result of one cylinder, except when one cylinder shows evidence of improper sampling, molding or testing, in which case it shall be discarded and strength of spare cylinder shall be used.
2. Make weight tests of hardened lightweight structural concrete in accordance with ASTM C567.
3. Furnish certified compression test reports (duplicate) to COTR. In test report, indicate the following information:
   a. Cylinder identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Type of concrete, slump, and percent air.
   d. Compressive strength of concrete in MPa (psi).
   e. Weight of lightweight structural concrete in kg/m^3 (pounds per cubic feet).
   f. Weather conditions during placing.
   g. Temperature of concrete in each test cylinder when test cylinder was molded.
   h. Maximum and minimum ambient temperature during placing.
   i. Ambient temperature when concrete sample in test cylinder was taken.
   j. Date delivered to laboratory and date tested.

3.7 REINFORCEMENT:

A. Perform sampling at fabricating plant. Take two samples from each 23 t (25 tons) or fraction thereof of each size of reinforcing steel No. 10 thru No. 57 (No. 3 thru No. 18).

B. Make one tensile and one bend test in accordance with ASTM A370 from each pair of samples obtained.

C. Written report shall include, in addition to test results, heat number, manufacturer, type and grade of steel, and bar size.

D. Perform tension tests of mechanical and welded splices in accordance with ASTM A370.

3.8 SHOTCRETE:

A. Inspection and Material Testing:

1. Provide field inspection and testing service as required by COTR to certify that shotcrete has been applied in accordance with contract documents.
2. Periodically inspect and test proportioning equipment for accuracy and report deficiencies to COTR.
3. Sample and test mix ingredients as necessary to insure compliance with specifications.
4. Sample and test aggregates daily and as necessary for moisture content. Report instances of excessive moisture to COTR.
5. Certify, in duplicate, that ingredients and proportions and amounts of ingredients in shotcrete conform to approved trial mixes.
6. Provide field inspection of the proper size and placement of the reinforcement in the shotcrete.

B. Shotcrete Sampling:
1. Provide a technician at site of placement to perform shotcrete sampling.
2. Take cores in accordance with ACI 506.
3. Insure maintenance of water-cement ratio established by approved trial mix.
4. Verify specified mixing has been accomplished.

C. Laboratory Tests of Field Sample Panels:
1. Compression test core for strength in accordance with ACI 506. For each test series of three cores, test one core at 7 days and one core at 28 days. Use remaining core as a spare to be tested at either 7 or 28 days as required. Compile laboratory test reports as follows: Compressive strength test shall be result of one core, except when one core shows evidence of improper sampling or testing, in which case it shall be discarded and strength of spare core shall be used.
2. Submit certified compression test reports (duplicate) to COTR. On test report, indicate following information:
   a. Core identification number and date cast.
   b. Specific location at which test samples were taken.
   c. Compressive strength of shotcrete in MPa (psi).
   d. Weather conditions during placing.
   e. Temperature of shotcrete in each test core when test core was taken.
   f. Maximum and minimum ambient temperature during placing.
   g. Ambient temperature when shotcrete sample was taken.
   h. Date delivered to laboratory and date tested.

D. Submit inspection reports certification and instances of noncompliance to COTR.

3.9 ARCHITECTURAL PRECAST CONCRETE:

A. Inspection at Plant: Forms, placement of reinforcing steel, concrete cover, and placement and finishing of concrete.

B. Concrete Testing: Test concrete including materials for concrete as required in Article CONCRETE of this section, except make two test cylinders for each day's production of each strength of concrete produced.

C. Inspect members to insure specification requirements for curing and finishes have been met.

3.10 MASONRY:

A. Mortar Tests:

1. Laboratory compressive strength test:
   a. Comply with ASTM C780.
   b. Obtain samples during or immediately after discharge from batch mixer.
   c. Furnish molds with 50 mm (2 inch), 3 compartment gang cube.
   d. Test one sample at 7 days and 2 samples at 28 days.
2. Two tests during first week of operation; one test per week after initial test until masonry completion.

B. Grout Tests:

1. Laboratory compressive strength test:
   a. Comply with ASTM C1019.
   b. Test one sample at 7 days and 2 samples at 28 days.
   c. Perform test for each 230 m^2 (2500 square feet) of masonry.

C. Masonry Unit Tests:

1. Laboratory Compressive Strength Test:
   a. Comply with ASTM C140.
   b. Test 3 samples for each 460 m^2 (5000 square feet) of wall area.

D. Prism Tests: For each type of wall construction indicated, test masonry prisms per ASTM C1314 for each 460 m^2 (5000 square feet) of wall area. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

3.11 STRUCTURAL STEEL:

A. General: Provide shop and field inspection and testing services to certify structural steel work is done in accordance with contract documents. Welding shall conform to AWS D1.1 Structural Welding Code.

B. Prefabrication Inspection:

1. Review design and shop detail drawings for size, length, type and location of all welds to be made.

2. Approve welding procedure qualifications either by pre-qualification or by witnessing qualifications tests.
3. Approve welder qualifications by certification or retesting.
4. Approve procedure for control of distortion and shrinkage stresses.
5. Approve procedures for welding in accordance with applicable sections of AWS D1.1.

C. Fabrication and Erection:
1. Weld Inspection:
   a. Inspect welding equipment for capacity, maintenance and working condition.
   b. Verify specified electrodes and handling and storage of electrodes in accordance with AWS D1.1.
   c. Inspect preparation and assembly of materials to be welded for conformance with AWS D1.1.
   d. Inspect preheating and interpass temperatures for conformance with AWS D1.1.
   e. Measure 25 percent of fillet welds.
   f. Welding Magnetic Particle Testing: Test in accordance with ASTM E709 for a minimum of:
      1) 20 percent of all shear plate fillet welds at random, final pass only.
      2) 20 percent of all continuity plate and bracing gusset plate fillet welds, at random, final pass only.
      3) 100 percent of tension member fillet welds (i.e., hanger connection plates and other similar connections) for root and final passes.
      4) 20 percent of length of built-up column member partial penetration and fillet welds at random for root and final passes.
      5) 100 percent of length of built-up girder member partial penetration and fillet welds for root and final passes.
   g. Welding Ultrasonic Testing: Test in accordance with ASTM E164 and AWS D1.1 for 100 percent of all full penetration welds, braced and moment frame column splices, and a minimum of 20 percent of all other partial penetration column splices, at random.
   i. Verify that correction of rejected welds are made in accordance with AWS D1.1.
   j. Testing and inspection do not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with the specified requirements.
2. Bolt Inspection:

a. Inspect high-strength bolted connections in accordance AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.
b. Slip-Critical Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in each connection in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
c. Fully Pre-tensioned Connections: Inspect 10 percent of bolts, but not less than 2 bolts, selected at random in 25 percent of connections in accordance with AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Inspect all bolts in connection when one or more are rejected.
d. Bolts installed by turn-of-nut tightening may be inspected with calibrated wrench when visual inspection was not performed during tightening.
e. Snug Tight Connections: Inspect 10 percent of connections verifying that plies of connected elements have been brought into snug contact.
f. Inspect field erected assemblies; verify locations of structural steel for plumbness, level, and alignment.

D. Submit inspection reports, record of welders and their certification, and identification, and instances of noncompliance to COTR.

3.12 TYPE OF TEST:

	Approximate Number of Tests Required
A. Earthwork:	
Laboratory Compaction Test, Soils:	
//(AASHTO T180)//(AASHTO T99)//(ASTM D1557)//(ASTM D698)//	_____
Field Density, Soils (AASHTO T191, T205, or T238)	_____
Penetration Test, Soils	_____
B. Landscaping:	
Topsoil Test	_____

C. Aggregate Base:

Laboratory Compaction, // (AASHTO T180)// //(ASTM D1557)// _____

Field Density,//(AASHTO T191)// //(ASTM D1556)// _____

Aggregate, Base Course

Gradation (AASHTO T27) _____

Wear (AASHTO T96) _____

Soundness (AASHTO T104) _____

D. Asphalt Concrete:

Field Density, (AASHTO T230)//ASTM D1188// _____

Aggregate, Asphalt Concrete

Gradation (AASHTO T27) _____

Wear (AASHTO T96) _____

Soundness (AASHTO T104) _____

E. Concrete:

Making and Curing Concrete Test Cylinders (ASTM C31) _____

Compressive Strength, Test Cylinders (ASTM C39) _____

Concrete Slump Test (ASTM C143) _____

Concrete Air Content Test (ASTM C173) _____

Unit Weight, Lightweight Concrete (ASTM C567) _____

Aggregate, Normal Weight:

Gradation (ASTM C33) _____

Deleterious Substances (ASTM C33) _____

Soundness (ASTM C33) _____

Abrasion (ASTM C33) _____

Aggregate, Lightweight

Gradation (ASTM C330) _____

Deleterious Substances (ASTM C330) _____

Unit Weight (ASTM C330) _____

Flatness and Levelness Readings (ASTM E1155) (number of days) _____

F. Reinforcing Steel:

Tensile Test (ASTM A370) _____

Bend Test (ASTM A370) _____

Mechanical Splice (ASTM A370) _____

Welded Splice Test (ASTM A370) _____

G. Shotcrete:

Taking and Curing Test Cores (ACI 506) _____
Compressive Strength, Test Cores (ACI 506) _____

H. Prestressed Concrete:
Testing Strands (ASTM A416) _____

I. Masonry:
Making and Curing Test Cubes (ASTM C109) _____
Compressive Strength, Test Cubes (ASTM C109) _____
Sampling and Testing Mortar, Comp. Strength (ASTM C780) _____
Sampling and Testing Grout, Comp. Strength (ASTM C1019) _____
Masonry Unit, Compressive Strength (ASTM C140) _____
Prism Tests (ASTM C1314) _____

J. Structural Steel:
Ultrasonic Testing of Welds (ASTM E164) _____
Magnetic Particle Testing of Welds (ASTM E709) _____
Radiographic Testing of Welds (ASTM E94) _____

L. Inspection:
Technical Personnel (Man-days) _____//

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SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT

1.1 DESCRIPTION

This specification covers the requirements for management of non-hazardous building construction and demolition waste.

1.2 RELATED WORK

A. Section 02 41 00, DEMOLITION.

B. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.

C. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

D. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

E. Reserved items which are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

1.3 GOVERNMENT POLICY

A. Contractor shall practice efficient waste management when sizing, cutting and installing building construction products.

B. Contractor shall use all reasonable means to divert construction and demolition waste from landfills and incinerators and facilitate their recycling.

C. Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling and any revenues or savings obtained from salvage or recycling shall accrue to the Contractor.

D. Contractor shall ensure that facilities used for recycling, reuse and disposal shall be permitted for the intended use to the extent required by federal, state and local regulations.

1.4 PLAN

A. Conduct a site assessment to estimate the types of materials that will be generated by demolition at the site. The Whole Building Design Guide website (http://www.wbdg.org) has a Construction Waste Management Database that contains information on companies that haul, collect, and process recyclable debris from construction projects

B. Develop and implement procedures to reuse and recycle materials to the greatest extent feasible based upon the contract, the construction and demolition debris management plan, the estimated

quantities of materials, and the availability of recycling facilities.

C. Prepare and submit to the COTR a written demolition debris management plan. The plan shall include, but not be limited to, the following information:
   1. Contractor and project identification information;
   2. Procedures to be used for debris management;
   3. A listing of the materials to be reused, recycled, or taken to the landfill.
   4. The names and locations of reuse and recycling facilities or sites.

1.5 COLLECTION

A. Provide necessary containers, bins and storage areas to facilitate effective waste management.

B. Clearly identify so that recyclable materials are separated from trash and can be transported to respective recycling facility for processing.

1.6 DISPOSAL

A. Contractor shall be responsible for transporting and disposing of materials that cannot be delivered to a source-separated or mixed materials recycling facility to a transfer station or disposal facility that can accept the materials in accordance with state law.

B. Building or demolition materials with no practical use or that cannot be recycled shall be disposed of at a landfill or incinerator.

1.7 REPORT

With each application for progress payment, the contractor shall submit a summary of construction and demolition debris diversion and disposal, quantifying all materials generated at the work site and disposed of or diverted from disposal through recycling.

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SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

EP-1. DESCRIPTION

A. This section specifies the control of environmental pollution and damage that the Contractor must consider for air, water, and land resources. It includes management of visual aesthetics, noise, solid waste, radiant energy, and radioactive materials, as well as other pollutants and resources encountered or generated by the Contractor. The Contractor is obligated to consider specified control measures with the costs included within the various contract items of work.

B. Environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which:
   1. Adversely effect human health or welfare,
   2. Unfavorably alter ecological balances of importance to human life,
   3. Effect other species of importance to humankind, or;
   4. Degrade the utility of the environment for aesthetic, cultural, and historical purposes.

C. Definitions of Pollutants:
   1. Chemical Waste: Petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals, and inorganic wastes.
   2. Debris: Combustible and noncombustible wastes, such as leaves, tree trimmings, ashes, and waste materials resulting from construction or maintenance and repair work.
   3. Sediment: Soil and other debris that has been eroded and transported by runoff water.
   4. Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, and agricultural operations and from community activities.
   5. Surface Discharge: The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "water of the United States" and would require a permit to discharge water from the governing agency.
   6. Rubbish: Combustible and noncombustible wastes such as paper, boxes, glass and crockery, metal and lumber scrap, tin cans, and bones.

7. Sanitary Wastes:
   a. Sewage: Domestic sanitary sewage and human and animal waste.
   b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

EP-2. QUALITY CONTROL

A. Establish and maintain quality control for the environmental protection of all items set forth herein.

B. Record on daily reports any problems in complying with laws, regulations, and ordinances. Note any corrective action taken.

EP-3. REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. U.S. National Archives and Records Administration (NARA):
33 CFR 328.....Definitions

EP-4. SUBMITTALS

A. In accordance with Section, 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

1. Environmental Protection Plan: After the contract is awarded and prior to the commencement of the work, the Contractor shall meet with the COTR to discuss the proposed Environmental Protection Plan and to develop mutual understanding relative to details of environmental protection. Not more than 20 days after the meeting, the Contractor shall prepare and submit to the COTR and the Contracting Officer for approval, a written and/or graphic Environmental Protection Plan including, but not limited to, the following:
   a. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
   b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site.
   C. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
   d. Description of the Contractor's environmental protection personnel training program.
   e. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control, noise control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.

f. Methods for protection of features to be preserved within authorized work areas including trees, shrubs, vines, grasses, ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, and archeological and cultural resources.

g. Procedures to provide the environmental protection that comply with the applicable laws and regulations. Describe the procedures to correct pollution of the environment due to accident, natural causes, or failure to follow the procedures as described in the Environmental Protection Plan.

h. Permits, licenses, and the location of the solid waste disposal area.

i. Drawings showing locations of any proposed temporary excavations or embankments for haul roads, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials. Include as part of an Erosion Control Plan approved by the District Office of the U.S. Soil Conservation Service and the Department of Veterans Affairs.

j. Environmental Monitoring Plans for the job site including land, water, air, and noise.

k. Work Area Plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas. This plan may be incorporated within the Erosion Control Plan.

B. Approval of the Contractor's Environmental Protection Plan will not relieve the Contractor of responsibility for adequate and continued control of pollutants and other environmental protection measures.

EP-5. PROTECTION OF ENVIRONMENTAL RESOURCES

A. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this contract. Confine activities to areas defined by the specifications and drawings.

B. Protection of Land Resources: Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the COTR. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

1. Work Area Limits: Prior to any construction, mark the areas that require work to be performed under this contract. Mark or fence

isolated areas within the general work area that are to be saved and protected. Protect monuments, works of art, and markers before construction operations begin. Convey to all personnel the purpose of marking and protecting all necessary objects.

2. Protection of Landscape: Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using any other approved techniques.
   a. Box and protect from damage existing trees and shrubs to remain on the construction site.
   b. Immediately repair all damage to existing trees and shrubs by trimming, cleaning, and painting with antiseptic tree paint.
   c. Do not store building materials or perform construction activities closer to existing trees or shrubs than the farthest extension of their limbs.
3. Reduction of Exposure of Unprotected Erodible Soils: Plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.
4. Temporary Protection of Disturbed Areas: Construct diversion ditches, benches, and berms to retard and divert runoff from the construction site to protected drainage areas approved under paragraph 208 of the Clean Water Act.

   a. Sediment Basins: Trap sediment from construction areas in temporary or permanent sediment basins that accommodate the runoff of a local 10 (design year) storm. After each storm, pump the basins dry and remove the accumulated sediment. Control overflow/drainage with paved weirs or by vertical overflow pipes, draining from the surface.
   b. Reuse or conserve the collected topsoil sediment as directed by the COTR. Topsoil use and requirements are specified in Section 31 20 00, EARTH MOVING.
   c. Institute effluent quality monitoring programs as required by Federal, State, and local environmental agencies.
5. Erosion and Sedimentation Control Devices: The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's activities. Construct or install all temporary and permanent erosion and sedimentation control features shown. Maintain

temporary erosion and sediment control measures such as berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.

6. Manage borrow areas on Government property to minimize erosion and to prevent sediment from entering nearby water courses or lakes.
7. Manage and control spoil areas on Government property to limit spoil to areas shown and prevent erosion of soil or sediment from entering nearby water courses or lakes.
8. Protect adjacent areas from despoilment by temporary excavations and embankments.
9. Handle and dispose of solid wastes in such a manner that will prevent contamination of the environment. Place solid wastes (excluding clearing debris) in containers that are emptied on a regular schedule. Transport all solid waste off Government property and dispose of waste in compliance with Federal, State, and local requirements.
10. Store chemical waste away from the work areas in corrosion resistant containers and dispose of waste in accordance with Federal, State, and local regulations.
11. Handle discarded materials other than those included in the solid waste category as directed by the COTR.

C. Protection of Water Resources: Keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters and sewer systems. Implement management techniques to control water pollution by the listed construction activities that are included in this contract.

1. Washing and Curing Water: Do not allow wastewater directly derived from construction activities to enter water areas. Collect and place wastewater in retention ponds allowing the suspended material to settle, the pollutants to separate, or the water to evaporate.
2. Control movement of materials and equipment at stream crossings during construction to prevent violation of water pollution control standards of the Federal, State, or local government.

3. Monitor water areas affected by construction.

D. Protection of Fish and Wildlife Resources: Keep construction activities under surveillance, management, and control to minimize interference with, disturbance of, or damage to fish and wildlife. Prior to beginning construction operations, list species that require specific attention along with measures for their protection.

E. Protection of Air Resources: Keep construction activities under surveillance, management, and control to minimize pollution of air resources. Burning is not permitted on the job site. Keep activities, equipment, processes, and work operated or performed, in strict accordance with the State of Illinois and Federal emission and performance laws and standards. Maintain ambient air quality standards set by the Environmental Protection Agency, for those construction operations and activities specified.
   1. Particulates: Control dust particles, aerosols, and gaseous by-products from all construction activities, processing, and preparation of materials (such as from asphaltic batch plants) at all times, including weekends, holidays, and hours when work is not in progress.
   2. Particulates Control: Maintain all excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and all other work areas within or outside the project boundaries free from particulates which would cause a hazard or a nuisance. Sprinklering, chemical treatment of an approved type, light bituminous treatment, baghouse, scrubbers, electrostatic precipitators, or other methods are permitted to control particulates in the work area.
   3. Hydrocarbons and Carbon Monoxide: Control monoxide emissions from equipment to Federal and State allowable limits.
   4. Odors: Control odors of construction activities and prevent obnoxious odors from occurring.

F. Reduction of Noise: Minimize noise using every action possible. Perform noise-producing work in less sensitive hours of the day or week as directed by the COTR. Maintain noise-produced work at or below the decibel levels and within the time periods specified.
   1. Perform construction activities involving repetitive, high-level impact noise only between 8:00 a.m. and 4:00p.m unless otherwise permitted by local ordinance or the COTR. Repetitive impact noise on the property shall not exceed the following dB limitations:

Time Duration of Impact Noise	Sound Level in dB
More than 12 minutes in any hour	70
Less than 30 seconds of any hour	85
Less than three minutes of any hour	80
Less than 12 minutes of any hour	75

2. Provide sound-deadening devices on equipment and take noise abatement measures that are necessary to comply with the requirements of this contract, consisting of, but not limited to, the following:
   a. Maintain maximum permissible construction equipment noise levels at 15 m (50 feet) (dBA):

EARTHMOVING		MATERIALS HANDLING	
FRONT LOADERS	75	CONCRETE MIXERS	75
BACKHOES	75	CONCRETE PUMPS	75
DOZERS	75	CRANES	75
TRACTORS	75	DERRICKS IMPACT	75
SCAPERS	80	PILE DRIVERS	95
GRADERS	75	JACK HAMMERS	75
TRUCKS	75	ROCK DRILLS	80
PAVERS, STATIONARY	80	PNEUMATIC TOOLS	80
PUMPS	75	BLASTING	//--//
GENERATORS	75	SAWS	75
COMPRESSORS	75	VIBRATORS	75

   b. Use shields or other physical barriers to restrict noise transmission.
   c. Provide soundproof housings or enclosures for noise-producing machinery.
   d. Use efficient silencers on equipment air intakes.
   e. Use efficient intake and exhaust mufflers on internal combustion engines that are maintained so equipment performs below noise levels specified.
   f. Line hoppers and storage bins with sound deadening material.
   g. Conduct truck loading, unloading, and hauling operations so that noise is kept to a minimum.
3. Measure sound level for noise exposure due to the construction at least once every five successive working days while work is being performed above 55 dB(A) noise level. Measure noise exposure at the property line or 15 m (50 feet) from the noise source, whichever is greater. Measure the sound levels on the A weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, take measurements at 900 to 1800 mm (three to six feet) in front of any building face. Submit the recorded information to the COTR noting any problems and the alternatives for mitigating actions.

G. Restoration of Damaged Property: If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the Contractor shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the Government. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.

H. Final Clean-up: On completion of project and after removal of all debris, rubbish, and temporary construction, Contractor shall leave the construction area in a clean condition satisfactory to the COTR. Cleaning shall include off the station disposal of all items and materials not required to be salvaged, as well as all debris and rubbish resulting from demolition and new work operations.

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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies demolition and removal of buildings, portions of buildings, utilities, other structures and debris from trash dumps shown.

1.2 RELATED WORK:

A. Demolition and removal of roads, walks, curbs, and on-grade slabs outside buildings to be demolished: Section 31 20 00, EARTH MOVING.

B. Safety Requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Disconnecting utility services prior to demolition: Section 01 00 00, GENERAL REQUIREMENTS.

D. Reserved items that are to remain the property of the Government: Section 01 00 00, GENERAL REQUIREMENTS.

F. Environmental Protection: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

G. Infectious Control: Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7, INFECTION PREVENTION MEASURES.

1.3 PROTECTION:

A. Perform demolition in such manner as to eliminate hazards to persons and property; to minimize interference with use of adjacent areas, utilities and structures or interruption of use of such utilities; and to provide free passage to and from such adjacent areas of structures. Comply with requirements of Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

B. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations. Comply with requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS.

C. Maintain fences, barricades, lights, and other similar items around exposed excavations until such excavations have been completely filled.

D. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum. Do not use water if it results in hazardous or objectionable condition such as, but not limited to; ice, flooding, or pollution. Vacuum and dust the work area daily.

E. Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The contractor shall take necessary precautions to avoid damages to existing items to remain in place, to be reused, or to remain the property of the Cemetery Property; any damaged items shall be repaired or replaced as approved by the COTR. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition or removal works. Repairs, reinforcement, or structural replacement must have COTR’s approval.

F. The work shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

G. The work shall comply with the requirements of Section 01 00 00, GENERAL REQUIREMENTS, Article 1.7 INFECTION PREVENTION MEASURES.

1.4 UTILITY SERVICES:

A. Demolish and remove outside utility service lines shown to be removed.

B. Remove abandoned outside utility lines that would interfere with installation of new utility lines and new construction.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION:

A. Debris, including brick, concrete, stone, metals and similar materials shall become property of Contractor and shall be disposed of by him daily, off the Cemetery Property to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the COTR. Break up concrete slabs below grade that do not require removal from present location into pieces not exceeding 600 mm (24 inches) square to permit drainage. Contractor shall dispose debris in compliance with applicable federal, state or local permits, rules and/or regulations.

B. Remove and legally dispose of all materials, other than earth to remain as part of project work. Materials removed shall become property of contractor and shall be disposed of in compliance with applicable federal, state or local permits, rules and/or regulations.

C. Remove existing utilities as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COTR. When Utility lines are encountered that are not indicated on the drawings, the COTR shall be notified prior to further work in that area.

3.2 CLEAN-UP:

On completion of work of this section and after removal of all debris, leave site in clean condition satisfactory to COTR. Clean-up shall include off the Cemetery Property disposal of all items and materials not required to remain property of the Government as well as all debris and rubbish resulting from demolition operations.

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section specifies cast-in-place structural concrete and materials and mixes for other concrete.

1.2 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Concrete roads, walks, and similar exterior site work: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

1.3 TESTING AGENCY FOR CONCRETE MIX DESIGN:

A. Testing agency retained and reimbursed by the Contractor and approved by COTR.

B. Testing agency maintaining active participation in Program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology.

C. Testing agency shall furnish equipment and qualified technicians to establish proportions of ingredients for concrete mixes.

1.4 TOLERANCES:

A. Formwork: ACI 117, except the elevation tolerance of formed surfaces before removal of shores is +0 mm (+0 inch) and -20 mm (-3/4 inch).

B. Reinforcement Fabricating and Placing: ACI 117, except that fabrication tolerance for bar sizes Nos. 10, 13, and 16 (Nos. 3, 4, and 5) (Tolerance Symbol 1 in Fig. 2.1(a), ACI, 117) used as column ties or stirrups is +0 mm (+0 inch) and -13 mm (-1/2 inch) where gross bar length is less than 3600 mm (12 feet), or +0 mm (+0 inch) and -20 mm (-3/4 inch) where gross bar length is 3600 mm (12 feet) or more.

C. Cross-Sectional Dimension: ACI 117, except tolerance for thickness of slabs 12 inches or less is +20 mm (+3/4 inch) and - 6 mm (-1/4 inch). Tolerance of thickness of beams more than 300 mm (12 inch) but less than 900 mm (3 feet) is +20 mm (+3/4 inch) and -10 mm (-3/8 inch).

1.5 REGULATORY REQUIREMENTS:

A. ACI SP-66 – ACI Detailing Manual.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ACI 301 – Standard Specifications for Structural Concrete.

1.6 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA.

B. Shop Drawings: Reinforcing steel: Complete shop drawings

C. Mill Test Reports:

1. Reinforcing Steel.
2. Cement.

D. Manufacturer's Certificates:

1. Abrasive aggregate.
2. Lightweight aggregate for structural concrete.
3. Air-entraining admixture.
4. Chemical admixtures, including chloride ion content.
5. Waterproof paper for curing concrete.
6. Liquid membrane-forming compounds for curing concrete.
7. Non-shrinking grout.
8. Liquid hardener.
9. Waterstops.
10. Expansion joint filler.
11. Adhesive binder.

E. Testing Agency for Concrete Mix Design: Approval request including qualifications of principals and technicians and evidence of active participation in program of Cement and Concrete Reference Laboratory (CCRL) of National Institute of Standards and Technology.

F. Test Report for Concrete Mix Designs: Trial mixes including water-cement-fly ash ratio curves, concrete mix ingredients, and admixtures.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Conform to ACI 304. Store aggregate separately for each kind or grade, to prevent segregation of sizes and avoid inclusion of dirt and other materials.

B. Deliver cement in original sealed containers bearing name of brand and manufacturer, and marked with net weight of contents. Store in suitable watertight building in which floor is raised at least 300 mm (1 foot) above ground. Store bulk cement and fly ash in separate suitable bins.

C. Deliver other packaged materials for use in concrete in original sealed containers, plainly marked with manufacturer's name and brand, and protect from damage until used.

1.8 PRE-CONCRETE CONFERENCE:

A. General: At least 15 days prior to submittal of design mixes, conduct a meeting to review proposed methods of concrete construction to achieve the required results.

B. Agenda: Includes but is not limited to:
   1. Submittals.
   2. Coordination of work.
   3. Availability of material.
   4. Concrete mix design including admixtures.
   5. Methods of placing, finishing, and curing.
   6. Finish criteria required to obtain required flatness and levelness.
   7. Timing of floor finish measurements.
   8. Material inspection and testing.

C. Attendees: Include but not limited to representatives of Contractor; subcontractors involved in supplying, conveying, placing, finishing, and curing concrete; lightweight aggregate manufacturer; admixture manufacturers; COTR; Consulting Engineer; Department of Veterans Affairs retained testing laboratories for concrete testing and finish (F-number) verification.

D. Minutes of the meeting: Contractor shall take minutes and type and distribute the minutes to attendees within five days of the meeting.

1.9 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI):

117-06	Tolerances for Concrete Construction and Materials
211.1-02	Selecting Proportions for Normal, Heavyweight, and Mass Concrete
211.2-04	Selecting Proportions for Structural Lightweight Concrete
214R-02	Evaluation of Strength Test Results of Concrete
301-05	Structural Concrete
304R-2000	Guide for Measuring, Mixing, Transporting, and Placing Concrete
305R-06	Hot Weather Concreting
306R-(2002)	Cold Weather Concreting
308R-(2001)	Standard Practice for Curing Concrete
309R-05	Guide for Consolidation of Concrete
31808	Building Code Requirements for Reinforced Concrete and Commentary
347R-04	Guide to Formwork for Concrete
SP-66-04	ACI Detailing Manual

C. American National Standards Institute and American Hardboard Association (ANSI/AHA):

A135.4-2004.....Basic Hardboard

D. American Society for Testing and Materials (ASTM):

A82/A82M-07.....Steel Wire, Plain, for Concrete Reinforcement

A185/185M-07.....Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

A615/A615M-08.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A653/A653M-07.....Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

A706/A706M-06.....Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A767/A767M-05.....Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

A775/A775M-07.....Epoxy-Coated Reinforcing Steel Bars

A820-06.....Steel Fibers for Fiber-Reinforced Concrete

A996/A996M-06.....Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

C31/C31M-08.....Making and Curing Concrete Test Specimens in the field

C33-07.....Concrete Aggregates

C39/C39M-05.....Compressive Strength of Cylindrical Concrete Specimens

C94/C94M-07.....Ready-Mixed Concrete

C143/C143M-05.....Slump of Hydraulic Cement Concrete

C150-07.....Portland Cement

C171-07.....Sheet Materials for Curing Concrete

C172-07.....Sampling Freshly Mixed Concrete

C173-07.....Air Content of Freshly Mixed Concrete by the Volumetric Method

C192/C192M-07.....Making and Curing Concrete Test Specimens in the Laboratory

C231-08.....Air Content of Freshly Mixed Concrete by the Pressure Method

C260-06.....Air-Entraining Admixtures for Concrete

C309-07.....Liquid Membrane-Forming Compounds for Curing Concrete

C330-05.....Lightweight Aggregates for Structural Concrete

C494/C494M-08.....Chemical Admixtures for Concrete

C496-06.....Splitting Tensile Strength of Cylindrical Concrete Specimens
C567-05.....Density of Structural Lightweight Concrete
C618-05.....Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
C666/C666M-03.....Resistance of Concrete to Rapid Freezing and Thawing
C881/C881M-02.....Epoxy-Resin-Base Bonding Systems for Concrete
C1107/1107M-07.....Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
D6-95(R2006).....Loss on Heating of Oil and Asphaltic Compounds
D297-93(R2006).....Rubber Products-Chemical Analysis
D1751-04.....Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D4397-02.....Polyethylene Sheeting for Construction, Industrial and Agricultural Applications
E1155-96(R2008).....Determining F_F Floor Flatness and F_L Floor Levelness Numbers

E. American Welding Society (AWS):
D1.4-05.....Structural Welding Code - Reinforcing Steel

F. Concrete Reinforcing Steel Institute (CRSI):
Handbook 2008

G. National Cooperative Highway Research Program (NCHRP):
Report On.....Concrete Sealers for the Protection of Bridge Structures

H. U. S. Department of Commerce Product Standard (PS):
PS 1.....Construction and Industrial Plywood
PS 20.....American Softwood Lumber

I. U. S. Army Corps of Engineers Handbook for Concrete and Cement:
CRD C513.....Rubber Waterstops
CRD C572.....Polyvinyl Chloride Waterstops

PART 2 – PRODUCTS:

2.1 FORMS:

A. Wood: PS 20 free from loose knots and suitable to facilitate finishing concrete surface specified; tongue and grooved.

B. Plywood: PS-1 Exterior Grade B-B (concrete-form) 16 mm (5/8 inch), or 20 mm (3/4 inch) thick for unlined contact form. B-B High Density Concrete Form Overlay optional.

C. Metal for Concrete Rib-Type Construction: Steel (removal type) of suitable weight and form to provide required rigidity.

D. Permanent Steel Form for Concrete Slabs: Corrugated, ASTM A653, Grade E, and Galvanized, ASTM A653, G90. Provide venting where insulating concrete fill is used.

E. Corrugated Fiberboard Void Boxes: Double faced, completely impregnated with paraffin and laminated with moisture resistant adhesive, size as shown. Design forms to support not less than 48 kPa (1000 psf) and not lose more than 15 percent of their original strength after being completely submerged in water for 24 hours and then air dried.

F. Form Lining:

1. Hardboard: ANSI/AHA A135.4, Class 2 with one (S1S) smooth side)
2. Plywood: Grade B-B Exterior (concrete-form) not less than 6 mm (1/4 inch) thick.
3. Plastic, fiberglass, or elastomeric capable of reproducing the desired pattern or texture.

G. Form Ties: Develop a minimum working strength of 13.35 kN (3000 pounds) when fully assembled. Ties shall be adjustable in length to permit tightening of forms and not have any lugs, cones, washers to act as spreader within form, nor leave a hole larger than 20 mm (3/4 inch) diameter, or a depression in exposed concrete surface, or leave metal closer than 40 mm (1 1/2 inches) to concrete surface. Wire ties not permitted. Cutting ties back from concrete face not permitted.

2.2 MATERIALS:

A. Portland Cement: ASTM C150 Type I or II.

B. Fly Ash: ASTM C618, Class C or F including supplementary optional requirements relating to reactive aggregates and alkalies, and loss on ignition (LOI) not to exceed 5 percent.

C. Coarse Aggregate: ASTM C33.

1. Size 67 or Size 467 may be used for footings and walls over 300 mm (12 inches) thick.
2. Coarse aggregate for applied topping, encasement of steel columns, and metal pan stair fill shall be Size 7.
3. Maximum size of coarse aggregates not more than one-fifth of narrowest dimension between sides of forms, one-third of depth of slabs, nor three-fourth of minimum clear spacing between reinforcing bars.

D. Fine Aggregate: ASTM C33. Fine aggregate for applied concrete floor topping shall pass a 4.75 mm (No. 4) sieve, 10 percent maximum shall pass a 150 µm (No. 100) sieve.

E. Mixing Water: Fresh, clean, and potable.

F. Admixtures:
   1. Water Reducing Admixture: ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
   2. Water Reducing, Retarding Admixture: ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
   3. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
   4. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. Admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory of at least one year duration using an acceptable accelerated corrosion test method such as that using electrical potential measures.
   5. Air Entraining Admixture: ASTM C260.
   6. Calcium Nitrite corrosion inhibitor: ASTM C494 Type C.
   7. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
   8. Certification: Written conformance to the requirements above and the chloride ion content of the admixture prior to mix design review.

G. Vapor Barrier: ASTM D4397, 0.25 mm (10 mil).

H. Reinforcing Steel: ASTM A615, or ASTM A996, deformed, grade as shown.

I. Welded Wire Fabric: ASTM A185.

J. Reinforcing Bars to be Welded: ASTM A706.

K. Galvanized Reinforcing Bars: ASTM A767.

L. Epoxy Coated Reinforcing Bars: ASTM A775.

N. Cold Drawn Steel Wire: ASTM A82.

O. Supports, Spacers, and Chairs: Types which will hold reinforcement in position shown in accordance with requirements of ACI 318 except as specified.

P. Expansion Joint Filler: ASTM D1751.

Q. Sheet Materials for Curing Concrete: ASTM C171.

R. Liquid Densifier/Sealer: 100% active colorless aqueous siliconate solution.

S. Omitted

T. Non-Shrink Grout:
   1. ASTM C1107, pre-mixed, produce a compressive strength of at least 18 MPa at three days and 35 MPa (5000 psi) at 28 days. Furnish test data from an independent laboratory indicating that the grout when placed

at a fluid consistency shall achieve 95 percent bearing under a 1200 mm x 1200 mm (4 foot by 4 foot) base plate.

2. Where high fluidity or increased placing time is required, furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95 percent under an 450 mm x 900 mm (18 inch by 36 inch) base plate.

U. Adhesive Binder: ASTM C881.

1. Polyvinyl Chloride Waterstop: CRD C572.
2. Rubber Waterstops: CRD C513.
3. Bentonite Water Stop: Flexible strip of bentonite 25 mm x 20 mm (1 inch by 3/4 inch), weighing 8.7 kg/m (5.85 lbs. per foot) composed of Butyl Rubber Hydrocarbon (ASTM D297), Bentonite (SS-S-210-A) and Volatile Matter (ASTM D6).
4. Porous Backfill: Crushed stone or gravel graded from 25 mm to 20 mm (1 inch to 3/4 inch).
5. Synthetic Fibers: Monofilament or fibrillated polypropylene fibers for secondary reinforcing of concrete members. Use appropriate length and 0.9 kg/m^3 (1.5 lb. per cubic yard). Product shall have a UL rating.
6. Steel Fibers: ASTM A820, Type I cold drawn, high tensile steel wire for use as primary reinforcing in slab-on-grade. Minimum dosage rate 18 kg/m^3 (30 lb. per cubic yard).
7. Epoxy Joint Filler: Two component, 100 percent solids compound, with a minimum shore D hardness of 50.
8. Bonding Admixture: Non-rewettable, polymer modified, bonding compound.
9. Architectural Concrete: For areas designated as architectural concrete on the Contract Documents, use colored cements and specially selected aggregates as necessary to produce a concrete of a color and finish which exactly matches the designated sample panel.

2.3 CONCRETE MIXES:

A. Mix Designs: Proportioned in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318.

1. If trial mixes are used, make a set of at least 6 cylinders in accordance with ASTM C192 for test purposes from each trial mix; test three for compressive strength at 7 days and three at 28 days.
2. Submit a report of results of each test series, include a detailed listing of the proportions of trial mix or mixes, including cement, fly ash, admixtures, weight of fine and coarse aggregate per m^3 (cubic yard) measured dry rodded and damp loose, specific gravity,

fineness modulus, percentage of moisture, air content, water-cement -fly ash ratio, and consistency of each cylinder in terms of slump.

3. Prepare a curve showing relationship between water-cement-fly ash ratio at 7-day and 28-day compressive strengths. Plot each curve using at least three specimens.
4. If the field experience method is used, submit complete standard deviation analysis.

B. Fly Ash Testing: Submit certificate verifying conformance with specifications initially with mix design and for each truck load of fly ash delivered from source. Notify COTR immediately when change in source is anticipated. Prior to beginning trial mixes submit to the COTR the following representative samples of material to be used, properly identified source and project description and number, type of testing (complete chemical and physical), suitably packaged for shipment, and addressed as specified. Allow 60 calendar days for test results after submittal of sample.

1. Fly ash - 2.25 kg (five pounds).
2. Portland cement - 3.5 kg (8 pounds):

Address -Waterways Experiment Station (WES)
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
ATTN: Engineering Materials Group

C. After approval of mixes no substitution in material or change in proportions of approval mixes may be made without additional tests and approval of COTR or as specified. Making and testing of preliminary test cylinders may be carried on pending approval of cement and fly ash, providing Contractor and manufacturer certify that ingredients used in making test cylinders are the same. COTR may allow Contractor to proceed with depositing concrete for certain portions of work, pending final approval of cement and fly ash and approval of design mix.

D. Cement Factor: Maintain minimum cement factors in Table I regardless of compressive strength developed above minimums. Fly ash may be substituted for up to 20 percent of the minimum cement factor at option of Contractor, except fly ash may not be used in concrete designated as architectural concrete.

TABLE I - CEMENT AND WATER FACTORS FOR CONCRETE

Concrete Strength		Non-Air-Entrained	Air-Entrained	
Min. 28 Day Comp. Str. MPa (psi)	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio	Min. Cement kg/m^3 (lbs/c. yd)	Max. Water Cement Ratio
35 (5000)[1,3]	375 (630)	0.45	385 (650)	0.40
30 (4000)[1,3]	325 (550)	0.55	340 (570)	0.50
25 (3000)[1,3]	280 (470)	0.65	290 (490)	0.55
25 (3000)[1,2]	300 (500)	*	310 (520)	*

1. If trial mixes are used, the proposed mix design shall achieve a compressive strength 8.3 MPa (1200 psi) in excess of f'c. For concrete strengths above 35 Mpa (5000 psi), the proposed mix design shall achieve a compressive strength 9.7 MPa (1400 psi) in excess of f'c.
2. Lightweight Structural Concrete. Pump mixes may require higher cement values.
3. For concrete exposed to high sulfate content soils maximum water cement ratio is 0.44.

* Determined by Laboratory in accordance with ACI 211.1 for normal concrete or ACI 211.2 for lightweight structural concrete.

E. Maximum Slump: Maximum slump, as determined by ASTM C143 with tolerances as established by ASTM C94, for concrete to be vibrated shall be as shown in Table II.

TABLE II - MAXIMUM SLUMP, MM (INCHES)*

Type of Construction	Normal Weight Concrete	Lightweight Structural Concrete
Reinforced Footings and Substructure Walls	75mm (3 inches)	75 mm (3 inches)
Slabs, Beams, Reinforced Walls, and Building Columns	100 mm (4 inches)	100 mm (4 inches)

* Slump may be increased by the use of the approved high-range water-reducing admixture (superplasticizer). Tolerances as established by ASTM C94. Concrete containing the high-range-water-reducing admixture may have a maximum slump of 225 mm (9 inches). The concrete shall arrive at the job site at a slump of 50 mm to 75 mm (2 inches to 3 inches), and 75 mm to 100 mm (3 inches to 4 inches) for lightweight concrete. This

should be verified, and then the high-range-water-reducing admixture added to increase the slump to the approved level.

F. Air-Entrainment: Air-entrainment of normal weight concrete shall be 6 percent ±2%. Determine air content by either ASTM C173 or ASTM C231.

G. High early strength concrete, made with Type III cement or Type I cement plus non-corrosive accelerator, shall have a 7-day compressive strength equal to specified minimum 28-day compressive strength for concrete type specified made with standard Portland cement.

H. Concrete placed at air temperatures below 10 degrees C (50 degrees Fahrenheit) use non-corrosive, non-chloride accelerator. Concrete required to be air entrained use approved air entraining admixture. Pumped concrete, synthetic fiber concrete, architectural concrete, concrete required to be watertight, and concrete with a water/cement ratio below 0.50 use high-range water-reducing admixture (superplasticizer).

I. Durability: Use air entrainment for exterior exposed concrete subjected to freezing and thawing and other concrete shown or specified. Air content as shown in Table III.

J. Enforcing Strength Requirements: Test as specified in Section 01 45 29, TESTING LABORATORY SERVICES, during the progress of the work. Seven-day tests may be used as indicators of 28-day strength. Average of any three 28-day consecutive strength tests of laboratory-cured specimens representing each type of concrete shall be equal to or greater than specified strength. No single test shall be more than 3.5 MPa (500 psi) below specified strength. Interpret field test results in accordance with ACI 214. Should strengths shown by test specimens fall below required values, COTR may require any one or any combination of the following corrective actions, at no additional cost to the Government:
   1. Require changes in mix proportions by selecting one of the other appropriate trial mixes or changing proportions, including cement content, of approved trial mix.
   2. Require additional curing and protection.
   3. If five consecutive tests fall below 95 percent of minimum values given in Table I or if test results are so low as to raise a question as to the safety of the structure, COTR may direct Contractor to take cores from portions of the structure. Use results from cores tested by the Contractor retained testing agency to analyze structure.
   4. If strength of core drilled specimens falls below 85 percent of minimum value given in Table I, COTR may order load tests, made by Contractor retained testing agency, on portions of building so

affected. Load tests in accordance with ACI 318 and criteria of acceptability of concrete under test as given therein.

5. Concrete work, judged inadequate by structural analysis, by results of load test, or for any reason, shall be reinforced with additional construction or replaced, if directed by the COTR.

2.4 BATCHING AND MIXING:

A. General: Concrete shall be "Ready-Mixed" and comply with ACI 318 and ASTM C94, except as specified. Batch mixing at the site is permitted. Mixing process and equipment must be approved by COTR. With each batch of concrete, furnish certified delivery tickets listing information in Paragraph 16.1 and 16.2 of ASTM C94. Maximum delivery temperature of concrete is 38^{0}C (100 degrees Fahrenheit). Minimum delivery temperature as follows:

Atmospheric Temperature	Minimum Concrete Temperature
-1. degrees to 4.4 degrees C (30 degrees to 40 degrees F)	15.6 degrees C (60 degrees F.)
-17 degrees C to -1.1 degrees C (0 degrees to 30 degrees F.)	21 degrees C (70 degrees F.)

1. Services of aggregate manufacturer's representative shall be furnished during the design of trial mixes and as requested by the COTR for consultation during batching, mixing, and placing operations of lightweight structural concrete. Services will be required until field controls indicate that concrete of required quality is being furnished. Representative shall be thoroughly familiar with the structural lightweight aggregate, adjustment and control of mixes to produce concrete of required quality. Representative shall assist and advise COTR.

PART 3 – EXECUTION

3.1 FORMWORK:

A. General: Design in accordance with ACI 347 is the responsibility of the Contractor. The Contractor shall retain a registered Professional Engineer to design the formwork, shores, and reshores.

1. Form boards and plywood forms may be reused for contact surfaces of exposed concrete only if thoroughly cleaned, patched, and repaired and COTR approves their reuse.
2. Provide forms for concrete footings unless COTR determines forms are not necessary.

3. Corrugated fiberboard forms: Place forms on a smooth firm bed, set tight, with no buckled cartons to prevent horizontal displacement, and in a dry condition when concrete is placed.

B. Treating and Wetting: Treat or wet contact forms as follows:
   1. Coat plywood and board forms with non-staining form sealer. In hot weather, cool forms by wetting with cool water just before concrete is placed.
   2. Clean and coat removable metal forms with light form oil before reinforcement is placed. In hot weather, cool metal forms by thoroughly wetting with water just before placing concrete.
   3. Use sealer on reused plywood forms as specified for new material.

C. Size and Spacing of Studs: Size and space studs, wales and other framing members for wall forms so as not to exceed safe working stress of kind of lumber used nor to develop deflection greater than 1/270 of free span of member.

D. Unlined Forms: Use plywood forms to obtain a smooth finish for concrete surfaces. Tightly butt edges of sheets to prevent leakage. Back up all vertical joints solidly and nail edges of adjacent sheets to same stud with 6d box nails spaced not over 150 mm (6 inches) apart.

E. Lined Forms: May be used in lieu of unlined plywood forms. Back up form lining solidly with square edge board lumber securely nailed to studs with all edges in close contact to prevent bulging of lining. No joints in lining and backing may coincide. Nail abutted edges of sheets to same backing board. Nail lining at not over 200 mm (8 inches) on center along edges and with at least one nail to each square foot of surface area; nails to be 3d blued shingle or similar nails with thin flatheads.

F. Architectural Liner: Attach liner as recommended by the manufacturer with tight joints to prevent leakage.

G. Wall Form Ties: Locate wall form ties in symmetrically level horizontal rows at each line of wales and in plumb vertical tiers. Space ties to maintain true, plumb surfaces. Provide one row of ties within 150 mm (6 inches) above each construction joint. Space through-ties adjacent to horizontal and vertical construction joints not over 450 mm (18 inches) on center.
   1. Tighten row of ties at bottom of form just before placing concrete and, if necessary, during placing of concrete to prevent seepage of concrete and to obtain a clean line. Ties to be entirely removed shall be loosened 24 hours after concrete is placed and shall be pulled from least important face when removed.
   2. Coat surfaces of all metal that is to be removed with paraffin, cup grease or a suitable compound to facilitate removal.

H. Inserts, Sleeves, and Similar Items: Flashing reglets, steel strips, masonry ties, anchors, wood blocks, nailing strips, grounds, inserts, wire hangers, sleeves, drains, guard angles, forms for floor hinge boxes, inserts or bond blocks for elevator guide rails and supports, and other items specified as furnished under this and other sections of specifications and required to be in their final position at time concrete is placed shall be properly located, accurately positioned, and built into construction, and maintained securely in place.
   1. Locate inserts or hanger wires for furred and suspended ceilings only in bottom of concrete joists, or similar concrete member of overhead concrete joist construction.
   2. Install sleeves, inserts and similar items for mechanical services in accordance with drawings prepared specially for mechanical services. Contractor is responsible for accuracy and completeness of drawings and shall coordinate requirements for mechanical services and equipment.
   3. Do not install sleeves in beams, joists or columns except where shown or permitted by COTR. Install sleeves in beams, joists, or columns that are not shown, but are permitted by the COTR, and require no structural changes, at no additional cost to the Government.
   4. Minimum clear distance of embedded items such as conduit and pipe is at least three times diameter of conduit or pipe, except at stub-ups and other similar locations.
   5. Provide recesses and blockouts in floor slabs for door closers and other hardware as necessary in accordance with manufacturer's instructions.

I. Construction Tolerances:
   1. Set and maintain concrete formwork to assure erection of completed work within tolerances specified and to accommodate installation of other rough and finish materials. Accomplish remedial work necessary for correcting excessive tolerances. Erected work that exceeds specified tolerance limits shall be remedied or removed and replaced, at no additional cost to the Government.
   2. Permissible surface irregularities for various classes of materials are defined as "finishes" in specification sections covering individual materials. They are to be distinguished from tolerances specified which are applicable to surface irregularities of structural elements.

3.2 PLACING REINFORCEMENT:

A. General: Details of concrete reinforcement in accordance with ACI 318 and ACI 315, unless otherwise shown.

B. Placing: Place reinforcement conforming to CRSI DA4, unless otherwise shown.
   1. Place reinforcing bars accurately and tie securely at intersections and splices with 1.6 mm (16 gauge) black annealed wire. Secure reinforcing bars against displacement during the placing of concrete by spacers, chairs, or other similar supports. Portions of supports, spacers, and chairs in contact with formwork shall be made of plastic in areas that will be exposed when building is occupied. Type, number, and spacing of supports conform to ACI 315. Where concrete slabs are placed on ground, use concrete blocks or other non-corrodible material of proper height, for support of reinforcement. Use of brick or stone supports will not be permitted.
   2. Lap welded wire fabric at least 1 1/2 mesh panels plus end extension of wires not less than 300 mm (12 inches) in structural slabs. Lap welded wire fabric at least 1/2 mesh panels plus end extension of wires not less than 150 mm (6 inches) in slabs on grade.
   3. Splice column steel at no points other than at footings and floor levels unless otherwise shown.

C. Spacing: Minimum clear distances between parallel bars, except in columns and multiple layers of bars in beams shall be equal to nominal diameter of bars. Minimum clear spacing is 25 mm (1 inch) or 1-1/3 times maximum size of coarse aggregate.

D. Splicing: Splices of reinforcement made only as required or shown or specified. Accomplish splicing as follows:
   1. Lap splices: Do not use lap splices for bars larger than Number 36 (Number 11). Minimum lengths of lap as shown.
   2. Welded splices: Splicing by butt-welding of reinforcement permitted providing the weld develops in tension at least 125 percent of the yield strength (fy) for the bars. Welding conform to the requirements of AWS D1.4. Welded reinforcing steel conform to the chemical analysis requirements of AWS D1.4.
      a. Submit test reports indicating the chemical analysis to establish weldability of reinforcing steel.
      b. Submit a field quality control procedure to insure proper inspection, materials and welding procedure for welded splices.
      c. Department of Veterans Affairs retained testing agency shall test a minimum of three splices, for compliance, locations selected by COTR.
   3. Mechanical Splices: Develop in tension and compression at least 125 percent of the yield strength (fy) of the bars. Stresses of transition splices between two reinforcing bar sizes based on area of

smaller bar. Provide mechanical splices at locations indicated. Use approved exothermic, tapered threaded coupling, or swaged and threaded sleeve. Exposed threads and swaging in the field not permitted.

a. Initial qualification: In the presence of COTR, make three test mechanical splices of each bar size proposed to be spliced. Department of Veterans Affairs retained testing laboratory will perform load test.

b. During installation: Furnish, at no additional cost to the Government, one companion (sister) splice for every 50 splices for load testing. Department of Veterans Affairs retained testing laboratory will perform the load test.

E. Bending: Bend bars cold, unless otherwise approved. Do not field bend bars partially embedded in concrete, except when approved by COTR.

F. Cleaning: Metal reinforcement, at time concrete is placed, shall be free from loose flaky rust, mud, oil, or similar coatings that will reduce bond.

G. Future Bonding: Protect exposed reinforcement bars intended for bonding with future work by wrapping with felt and coating felt with a bituminous compound unless otherwise shown.

3.3 PLACING CONCRETE:

A. Preparation:

1. Remove hardened concrete, wood chips, shavings and other debris from forms.
2. Remove hardened concrete and foreign materials from interior surfaces of mixing and conveying equipment.
3. Have forms and reinforcement inspected and approved by COTR before depositing concrete.
4. Provide runways for wheeling equipment to convey concrete to point of deposit. Keep equipment on runways which are not supported by or bear on reinforcement. Provide similar runways for protection of vapor barrier on coarse fill.

B. Bonding: Before depositing new concrete on or against concrete which has been set, thoroughly roughen and clean existing surfaces of laitance, foreign matter, and loose particles.

1. Preparing surface for applied topping:
   a. Remove laitance, mortar, oil, grease, paint, or other foreign material by sand blasting. Clean with vacuum type equipment to remove sand and other loose material.
   b. Broom clean and keep base slab wet for at least four hours before topping is applied.

c. Use a thin coat of one part Portland cement, 1.5 parts fine sand, bonding admixture; and water at a 50: 50 ratio and mix to achieve the consistency of thick paint. Apply to a damp base slab by scrubbing with a stiff fiber brush. New concrete shall be placed while the bonding grout is still tacky.

C. Conveying Concrete: Convey concrete from mixer to final place of deposit by a method which will prevent segregation. Method of conveying concrete subject to approval of COTR.

D. Placing: For special requirements see Paragraphs, HOT WEATHER and COLD WEATHER.

1. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content more than 1 1/2 hours.
2. Deposit concrete in forms as near as practicable in its final position. Prevent splashing of forms or reinforcement with concrete in advance of placing concrete.
3. Do not drop concrete freely more than 3000 mm (10 feet) for concrete containing the high-range water-reducing admixture (superplasticizer) or 1500 mm (5 feet) for conventional concrete. Where greater drops are required, use a tremie or flexible spout (canvas elephant trunk), attached to a suitable hopper.
4. Discharge contents of tremies or flexible spouts in horizontal layers not exceeding 500 mm (20 inches) in thickness, and space tremies such as to provide a minimum of lateral movement of concrete.
5. Continuously place concrete until an entire unit between construction joints is placed. Rate and method of placing concrete shall be such that no concrete between construction joints will be deposited upon or against partly set concrete, after it's initial set has taken place, or after 45 minutes of elapsed time during concrete placement.
6. On bottom of members with severe congestion of reinforcement, deposit 25 mm (1 inch) layer of flowing concrete containing the specified high-range water-reducing admixture (superplasticizer). Successive concrete lifts may be a continuation of this concrete or concrete with a conventional slump.

E. Consolidation: Conform to ACI 309. Immediately after depositing, spade concrete next to forms, work around reinforcement and into angles of forms, tamp lightly by hand, and compact with mechanical vibrator applied directly into concrete at approximately 450 mm (18 inch) intervals. Mechanical vibrator shall be power driven, hand operated type with minimum frequency of 5000 cycles per minute having an intensity

sufficient to cause flow or settlement of concrete into place. Vibrate concrete to produce thorough compaction, complete embedment of reinforcement and concrete of uniform and maximum density without segregation of mix. Do not transport concrete in forms by vibration.

1. Use of form vibration shall be approved only when concrete sections are too thin or too inaccessible for use of internal vibration.
2. Carry on vibration continuously with placing of concrete. Do not insert vibrator into concrete that has begun to set.

3.4 HOT WEATHER:

Follow the recommendations of ACI 305 or as specified to prevent problems in the manufacturing, placing, and curing of concrete that can adversely affect the properties and serviceability of the hardened concrete. Methods proposed for cooling materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COTR. Necessary provisions for proper hot weather placement will be made at the Contractor’s expense.

3.5 COLD WEATHER:

Follow the recommendations of ACI 306 or as specified to prevent freezing of concrete and to permit concrete to gain strength properly. Use only the specified non-corrosive, non-chloride accelerator. Do not use calcium chloride, thiocyantes or admixtures containing more than 0.05 percent chloride ions. Methods proposed for heating materials and arrangements for protecting concrete shall be made in advance of concrete placement and approved by COTR. Necessary provisions for proper cold weather placement will be made at the Contractor’s expense.

3.6 PROTECTION AND CURING:

A. Conform to ACI 308: Initial curing shall immediately follow the finishing operation. Protect exposed surfaces of concrete from premature drying, wash by rain and running water, wind, mechanical injury, and excessively hot or cold temperatures. Keep concrete not covered with membrane or other curing material continuously wet for at least 7 days after placing, except wet curing period for high-early-strength concrete shall be not less than 3 days. Keep wood forms continuously wet to prevent moisture loss until forms are removed. Cure exposed concrete surfaces as described below. Other curing methods may be used if approved by COTR.

1. Liquid curing and sealing compounds: Apply by power-driven spray or roller in accordance with the manufacturer’s instructions. Apply immediately after finishing. Maximum coverage $10m^2/L$ (400 square feet per gallon) on steel troweled surfaces and $7.5m^2/L$ (300 square feet

per gallon) on floated or broomed surfaces for the curing/sealing compound.

2. Plastic sheets: Apply as soon as concrete has hardened sufficiently to prevent surface damage. Utilize widest practical width sheet and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with tape.
3. Paper: Utilize widest practical width paper and overlap adjacent sheets 50 mm (2 inches). Tightly seal joints with sand, wood planks, pressure-sensitive tape, mastic or glue.

3.7 REMOVAL OF FORMS:

A. Remove in a manner to assure complete safety of structure after the following conditions have been met.

1. Where structure as a whole is supported on shores, forms for beams and girder sides, columns, and similar vertical structural members may be removed after 24 hours, provided concrete has hardened sufficiently to prevent surface damage and curing is continued without any lapse in time as specified for exposed surfaces.
2. Take particular care in removing forms of architectural exposed concrete to insure surfaces are not marred or gouged, and that corners and arises are true, sharp and unbroken.

3.8 CONCRETE SURFACE PREPARATION:

A. Metal Removal: Unnecessary metal items cut back flush with face of concrete members.

B. Patching: Maintain curing and start patching as soon as forms are removed. Do not apply curing compounds to concrete surfaces requiring patching until patching is completed. Use cement mortar for patching of same composition as that used in concrete. Use white or gray Portland cement as necessary to obtain finish color matching surrounding concrete. Thoroughly clean areas to be patched. Cut out honeycombed or otherwise defective areas to solid concrete to a depth of not less than 25 mm (1 inch). Cut edge perpendicular to surface of concrete. Saturate with water area to be patched, and at least 150 mm (6 inches) surrounding before placing patching mortar. Give area to be patched a brush coat of cement grout followed immediately by patching mortar. Cement grout composed of one part Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio, mix to achieve consistency of thick paint. Mix patching mortar approximately 1 hour before placing and remix occasionally during this period without addition of water. Compact mortar into place and screed slightly higher than surrounding surface. After initial shrinkage has occurred, finish to match color and texture of adjoining surfaces. Cure patches as

specified for other concrete. Fill form tie holes which extend entirely through walls from unexposed face by means of a pressure gun or other suitable device to force mortar through wall. Wipe excess mortar off exposed face with a cloth.

C. Upon removal of forms, clean vertical concrete surface that is to receive bonded applied cementitious application with wire brushes or by sand blasting to remove unset material, laitance, and loose particles to expose aggregates to provide a clean, firm, granular surface for bond of applied finish.

3.9 CONCRETE FINISHES:

A. Vertical Surface Finishes:

1. Exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:
   a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
   b. Apply grout composed of one part of Portland cement, one part fine sand, smaller than a 600 µm (No. 30) sieve. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.
   c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about 1 hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
   d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.
2. Apply stain and finish per 03 45 50 PRECAST CONCRETE COLUMBARIUM UNITS, Section 2.13.

B. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to COTR and floor consultant for evaluation and recommendations for subsequent placements.
2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish

initial grade during strike-off, unless COTR determines that the method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strike-off elevation for all types of elevated (non slab-on-grade) slabs.

3. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strike-offs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strike-off. Repeat strike-off as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.
4. Immediately following screeding, and before any bleed water appears, use a wide straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.
6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 6 mm (1/4 inch) indentation.
7. Float Finish: Slabs to receive unbonded toppings, steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and re-float to a uniform texture.
8. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

9. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by COTR from sample panel.

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SECTION 03 45 50
PRECAST CONCRETE COLUMBARIUM UNITS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section covers the manufacturer and installation of precast concrete columbarium units, as shown on the Drawings and specified herein, including but not limited to: the steel reinforcement, steel embedment plates, required sleeves, finished exposed surfaces, anti-graffiti system, preparation of setting surface, adhesive, columbarium fasteners, and niche cover anchor clip assemblies.

C. Acceptable designs of the columbarium units components are provided as shown on the Drawings. The Contractor may use this design for this Work or may propose alternate designs of the corresponding components as follows:

1. Design for alternate columbarium units shall comply with the design criteria as per Articles 1.3.F and further, if required by the Contractor, shall comply with the functional tests as per Article 1.3.G of this Specification.
2. Unless indicated otherwise, all provisions of this Specification shall apply to the Contractor proposed design.
3. The Government may accept or reject part or all of any design proposed by the Contractor.

D. This section includes finishing and staining/coating of exposed faces of the columbarium units as indicated on Drawings or described herein.

E. This section covers acceptance and installation of the Contractor provided marble niche covers, one for each niche of the new columbarium units.

F. This section covers furnishing and installing an anti-graffiti coating system applied to the exterior exposed columbarium surfaces, precast units, cast-in-place concrete and stone piers (all exposed surfaces including the capstones).

1.2 RELATED WORK

A. Furnishing and installing Wall Cap Stones: Section 047200, CAST STONE MASONRY.

B. Masonry Mortaring: SECTION 040513

C. Masonry Units: Section 042000, UNIT MASONRY.

D. Flashing & Sheet Metal: Section 076000, FLASHING & SHEET METAL.

E. Joint Sealants: Section 079200, JOINT SEALANTS.

F. Marble Niche Cover Plate: Section 044220, MARBLE NICHE COVERS

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Prior to commencement of work, Contractor shall submit documentation regarding the experience of his precast concrete supplier in the design and manufacture of Precast Concrete structures and custom units. Design, fabrication, delivery, and erection shall conform to ACI 318-02. Perform all welding in accordance with AWS D1.1.

B. Precast concrete manufacturer’s qualified Registered Professional Structural Engineer to certify that precast reinforced concrete conforms to specified requirements and is capable of structurally supporting imposed cast stone cap loads.

C. Codes and regulations of the Federal, State, and County authorities shall apply.

D. Fabricate to dimensions shown or approved. Replace or correct Columbarium Units which do not comply with the individual dimensions and tolerances.

E. Before starting production of Precast Concrete Columbarium Units, furnish at the site, two complete Precast Concrete Columbarium Units to demonstrate quality of construction. Commence production of Columbarium Units only after written approval.

G. Design Criteria:

1. The Columbarium Units shall be of the following type, style, and size:
   a. Type: Precast concrete, reinforced.
   b. Size: Interior and exterior dimensions as indicated on plans.
2. Columbarium top shall be capable of structurally supporting imposed service live load of no less than 50 psf, plus additional loads based on cast stone capstone thickness, dimensions, and heights, including material composition and element sectional properties, mortar and grout, reinforcement and load bearing locations. Verify and coordinate with cast stone capstone manufacturer prior to manufacturing columbarium niche units.
3. The Contractor shall submit in accordance with Section 013323 – Samples & Shop Drawings, for review and approval, 5 sets of design documentation showing structural design of the complete Columbarium. This documentation shall include dimensions, methods of construction, and calculations. All design calculations and drawings shall be signed and sealed by qualified Professional Structural Engineer, registered in the State of Tennessee.

H. Functional Load Tests: If required by the COTR, a functional load test will be made at the Government’s expense to insure that the alternate columbarium proposed by the Contractor, as furnished, will be capable of supporting loads stated in Article 1.3.F.2. The functional test will consist of loading conditions:

1. Unconfined Loading: The columbarium will be placed on a flat surface with no support against the sides. The entire top of the columbarium will be subjected to a simulated uniform load of live load of 50 psf and required dead load simulating cast stone capstone, mortar, reinforcement, and grout. The simulated load shall bear at manufacturer recommended bearing location (quantity and location of load points determined by columbarium niche unit manufacturer) The load will be maintained for no less than 72 hours. At the end of the loading period, the maximum deflection of the Columbarium top elements shall be no more that 1/8". Upon removal of the load from the lid the residual deflection shall be no more than 1/16" and concrete elements shall be free of all structural distress.

1.4 MANUFACTURER / INSTALLER QUALIFICATIONS

A. Precast concrete columbarium units shall be product of manufacturer / installer who has a minimum of 3 years experience in fabrication and erection of the precast concrete columbarium units similar in material design and extent to that indicated on the drawings and specified herein.
B. Supply and Installation of fastener system shall be a product of manufacturer and installer both who have had a minimum of 3 years experience of installation of similar design as indicated on the drawing.
C. Installation of niche fronts will be performed by those companies who have had 3 years experience in installation of similar design as indicated in the drawings and specified herein.
D. Precast manufacturer plant(s) used to be National Precast Concrete Association (NPCA) certified.

1.5 ALLOWABLE TOLERANCES

A. In addition to tolerances of individual elements required by American Concrete Institution Publication 533.3R, erection tolerances shall be as follows:
   1. Variation of anchors and fasteners from dimensions specified....1/8 inch
   2. Variation in overall dimensions of precast element (height and width).. .....1/8 inch
   3. Maximum differential between adjacent units in erected position..... .....1/4 inch
   4. Variation in thickness of precast panels and elements.....1/8 inch
   5. Maximum vertical differential between adjacent columbarium units in installed position .....1/8 inch
   6. Variation in overall dimensions of back to back precast elements (width) .....1/4 inch

1.6 SUBMITTALS

A. Submit in accordance with Section 013323, SAMPLES AND SHOP DRAWINGS.
   1. Samples: all fastening systems; mounting hardware and exposed surface finishes including, but not limited to, the following:
      a. Stainless Steel Bolt, Nut and Washers
      b. Tamper Proof Stainless Steel Bolt
      c. Stainless Steel Rosette
      d. Stainless Steel Expansion Anchors, Bolts and pins
      e. Shims
      f. Exposed back of columbarium units with specified finish and anti-graffiti system installed before shipment.
      g. Exposed front of columbarium with coating applied.
      h. Adhesives and grouts.
   2. Shop Drawings: complete shop and erection drawings of all precast concrete columbarium units, showing all dimensions and details of construction, installation and relation to adjoining work, reinforcements, anchorage, attachments, inserts, location of all predrilled sleeves and other items to be installed in the work of other trades, joint treatment, joint alignment coordinated with cap stone joints, cap stone load bearing locations, and other work required for a complete installation. Provide evidence that the Contractor to be installing the cast in place concrete foundations for the columbarium and pier units has been contacted prior to any work relating to the footings for the columbarium construction and that the construction of the concrete support work has been coordinated with the precast columbarium unit manufacturer and installer.
   3. Manufacturer’s Literature and Data:
      a. Each type of Concrete Fastener, including adhesive and anchor devices
      b. Instructions for final cleaning
      c. Concrete stain/coating, including color charts of manufacturers standard color palette
   4. Certificates: Manufacturers qualifications specifying precast concrete columbarium units meet the requirements of ACI 533.3R and as specified.

1.7 DELIVERY, STORAGE

A. Ship precast concrete columbarium units to site with adequate protection to prevent chipping, breaking and other damage. Materials shall be marked giving proper identifications and location. Store materials in protected areas to prevent damage, injurious effects of weather and inclusion of foreign matter.

1.8 COORDINATION

A. Coordinate the manufacture and erection of precast concrete columbarium units with related work of other sections of the Specifications. Provide templates for inserts and other devices for anchoring precast concrete columbarium units to the work of other trades, in sufficient time to be built into adjoining construction. Perform cutting, fitting and other related work in connection with erection of precast concrete columbarium unit work. See Shop Drawing section for details regarding the coordination of work.

1.9 GUARANTEE

A. Guarantee precast concrete columbarium unit work, including anchorage, joint treatment and related components to be free from all defects in materials and workmanship, including cracking and spalling, and after erection, completed work will be subject to terms of “Guaranty” article in Division 1 Specification Sections except that guarantee period is one year.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below from a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

QQ-S-766C (5)	Steel Plates, Sheets, and Strip-Corrosion Resisting
QQ-W-423B	Wire, Steel, Corrosive-Resisting
TT-S-00227E (3)	Sealing Compound: Elastomeric Type, Multi-Component (For Caulking, Sealing, and Glazing in Building and Other Structures)
TT-S-00230C (2)	Sealing Compound: Elastomeric Type, Single Component (For Caulking, Sealing, and Glazing in Building and Other Structures)

C. American Concrete Institute (ACI) Publications:

ACI 533.3R-70	Fabrication, Handling and Erection of Precast Concrete
ACI 318	Building Code Requirements for Reinforced Concrete

D. American Society for Testing Materials (ASTM) Standards:

A36	Standard Specification for Carbon Structural Steel
A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement Welded

A615-87.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C33-86.....Concrete Aggregates
C150-86.....Portland Cement
C260.....Air Entraining Admixture
C494.....Water Reducing Admixture

E. American Welding Society (AWS) Publications:
AWS D1.1-90.....Structural Welding Code
AWS D1.4-80.....Welding Reinforcing Steel

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER/DESIGN

A. To establish an acceptable design as indicated herein, the Contractor is hereby notified that the columbarium unit design provided by Koppenburg Enterprises, Inc., 17501 147 Street SW, Monroe, WA 98272, (800) 574-2481, are established as an acceptable design quality conforming to these Specifications and Drawings. Utilize “Koppenburg” or an approved equal.

2.2 COARSE AGGREGATE

A. Hard durable aggregate carefully graded from coarse to fine in proportions required to match approved samples.

2.3 PORTLAND CEMENT

A. ASTM C150, Type I and Type II; Color as required.

2.4 STEEL WIRE REINFORCEMENT

A. ASTM A82, cold drawn.

2.5 REINFORCING STEEL

A. ASTM A615, deformed, Grade 60.

2.6 MISCELLANEOUS GALVANIZED STEEL ITEMS

A. Bolts, nuts, washers, anchors, inserts, and the like for handling, erection, or use by other trades.

2.7 MARBLE NICHE COVERS

A. Marble niche covers shall be furnished by the government and shall be installed by the contractor. The general quantity and condition shall be observed and an adequate count to cover all the installed columbarium units, plus required spares shall be verified by both the contractor and COTR. See also Section 044220 Marble Niche Covers. The contractor shall notify the COTR very early in the contract when the niche covers will be installed so the government has sufficient time for order and delivery of the niche covers.

2.8 NICHE COVER ATTACHMENT

A. United States Department of Military and Veterans Affairs, National Cemetery System, standard stainless steel rosette, mounting brackets, and bolts for complete attachment of the marble niche covers to the precast columbarium units.

2.9 BACK-UP MATERIAL

A. Closed sell neoprene, butyl, polyurethane, vinyl or polyethylene foam rod, diameter approximately 1-1/3 times the joint width.

2.10 BOND BREAKERS IF USED

A. Type and material recommended by sealant manufacturer.

2.11 SEALING COMPOUND IF USED

A. Fed. Spec. TT-S-00230 C, Type II, Class A, or ASTM C 920-87, Type S, Grade NS, Class 25.

2.12 FABRICATION

A. Precast concrete columbarium units shall NOT be: fabricated, delivered or incorporated in the work until samples and mock-up have been approved. Precast concrete shall comply with ACI 533.3R, expect as modified herein.
   1. Concrete for precast columbarium units shall have minimum compressive strength of 4,000 psi at 28 days.
   2. Provide additional steel reinforcing as required for casting, handling and erection loads.
   3. Back-up Mix: Porosity, strength, weight, and gradation of coarse aggregate shall be as required to produce specified characteristics.
   4. Columbarium units shall be cast in steel forms designed to suit shape and finish required and to withstand high frequency vibration. Concrete shall be deposited in plastic lined or metal forms that are true to line and plane. Vibrations, where required, shall be continuous during process of casting to attain through compaction, complete embedment of reinforcement and to assure concrete of uniform and maximum density without segregation of mix and full thickness of precast element is attained.
      a. Anchors, lifting devices, provisions for cutouts and openings, dovetail slots, notches, reglets, inserts and similar items required for the work of other trades shall be accurately positioned in forms before casting elements.
      b. All fastener location holes, including those for anchoring of units and attachment of niche covers, shall be cast into units. Drilling to precast concrete columbarium units, after fabrication, shall only be acceptable for bottom attachment to concrete base and for anchoring the capstones set on top of the units.

c. Identification: Provide permanent markings to identify pick-up points and orientation in structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface, which will not show in finished structure.

5. Cement, aggregate and water shall be obtained from single sources for facing mix of precast concrete work in order to assure regularity of appearance and uniformity of color.
6. Finish: Exposed faces shall have smooth finish, unless otherwise noted. Back side of single columbarium units, with back exposed to view shall have surface finish as indicated on the drawings. Specified surface finish for the exposed back of the columbarium units shall be applied during the appropriate time of fabrication and curing. Seal coating of exposed back of units shall be applied as per manufacturer's recommendations.
7. Curing: Precast concrete shall be cured as required to develop specified structural characteristics and shall be stored in a manner that will permit all surfaces to cure equally and minimize warping, without staining the exposed faces.

2.13 STAIN AND FINISH EXPOSED EDGES

A. Finish for all exposed faces and edges of columbarium units shall be coated with a color coat suitable for cured concrete, such as 'Sonocoat® Super Colorcoat™ VOC' manufactured by Sonneborn®, or approved equivalent. Color and texture to be approved by COTR prior to application of coating. Manufacturer's literature and color charts shall be submitted as part of the submittal process.

B. Anti-graffiti coating system. Furnish and install a permanent two coat anti-graffiti coating system, matte type finish (non-gloss), designed to be applied on concrete and brick surfaces and to provide a minimum life, as indicated in the manufacturer's literature, of 10 years. The coating system shall be clear.

PART 3 – EXECUTION

3.1 HANDLING AND INSTALLATION

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

B. Before beginning installation, inspect work of other trades in-so-far as it affects the work of this Section. Commencing installation of precast concrete columbarium units will be construed as acceptance, as suitable, of such work of other trades. Concrete base for the columbarium units

shall be inspected and modified as required, grinding off high spots, to become an acceptable base upon which to install the units. Columbarium units shall be handled in a nearly vertical plane at all times and stacked vertically on wood supports of adequate strength, until erected. Cover and protect precast concrete columbarium units against staining and other damage. Reinstall, realign and otherwise correct improper installed units.

1. Accurately place and securely anchor precast concrete columbarium units to adjoining construction in accordance with manufacturer's specifications. Provide shop and erection drawings as per manufacturer recommendations and specifications.

3.2 SETTING

A. Where shown, joints shall be filled with sealant/ Surfaces and other joints for precast concrete columbarium units shall be cleaned of all dust, dirt and other foreign matter. Exposed surfaces of units shall be protected by anti-graffiti coating at the manufacturer, or shall be protected until accepted by the VA following installation. Units that have been damaged on exposed surfaces by graffiti, when not coated in advance shall be rejected and removed from the site. Each precast element shall be set level and true to line with uniform joints.

B. Erect precast concrete members to conform to PCI Design handbook tolerances, except as follows:
   1. Variation in joint width ±1/4 inch.
   2. Maximum difference between bottom surfaces of adjacent plank 1/4 inch.

C. Joints required to have sealants shall be kept free of dirt and other contaminants for their full depth. Precautions shall be taken to protect precast concrete work from being damaged and soiled during and after installation. Wedges, spacers or other appliances which are likely to cause staining shall be removed from joints.

3.3 SEALING OF JOINTS

A. Where shown and where required to make work watertight, joints between precast concrete columbarium units and between other precast elements and adjoining masonry, concrete and other materials shall be filled with back-up material for depth extending as required to form joint of depth as shown or recommended by sealant manufacturer. Provide bond breakers, at base of sealant where space for back-up does not exist and to prevent sealant from bonding to material at base of joint.
   1. Workmanship shall be in accordance with Division 1 Specification Sections.

3.4 CLEANING

A. After erection is complete, clean precast columbarium units using materials, equipment and methods recommended by manufacturer.

3.5 REPLACEMENT AND REPAIR

A. Precast concrete columbarium units which are damaged, cracks, stained, improperly fabricated or otherwise defective shall be removed and be replaced. Precast units having minor defects not affecting serviceability or appearance may be repaired when approved by the COTR. Repaired work shall be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces, and shall show no line of demarcation between original and patched surfaces. Replacement and repairs shall be done at no additional cost to the Government.

3.6 FINISHING OF EXPOSED EDGES AND FACES

A. Apply coating to complete, clean exposed concrete edges as per manufacturer’s standard specifications and recommendations.

3.7 INSTALLATION OF MARBLE NICHE COVERS

A. Install niche covers plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. Tighten fasteners to achieve snug fit but do not over tighten to the point where they may crack or break niche covers.

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SECTION 04 05 13
MASONRY MORTARING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Section specifies mortar materials and mixes.

1.2 RELATED WORK:

A. Mortar used in Section:

1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
2. Section 04 20 00, UNIT MASONRY.
3. Section 04 72 00, CAST STONE MASONRY.

1.3 TESTING LABORATORY-CONTRACTOR RETAINED:

A. Engage a commercial testing laboratory approved by COTR to perform tests specified below.

B. Submit information regarding testing laboratory's facilities and qualifications of technical personnel to COTR.

1.4 TESTS:

A. Test mortar and materials specified.

B. Certified test reports.

C. Identify materials by type, brand name and manufacturer or by origin.

D. Do not use materials until laboratory test reports are approved by COTR.

E. After tests have been made and materials approved, do not change without additional test and approval of COTR.

F. Testing:

1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
2. Mortar:
   a. Test for compressive strength and water retention; ASTM C270.
   b. Mortar compressive strengths 28 days as follows:
      Type M: Minimum 17230 kPa (2500 psi) at 28 days.
      Type S: Minimum 12400 kPa (1800 psi) at 28 days.
      Type N: Minimum 5170 kPa (750 psi) at 28 days.
3. Cement:
   a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
   b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.

4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

G. During progress of work, testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES, takes and tests samples as specified in that section. Testing procedures and test methods in ASTM C780.

1.5 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Certificates:

1. Testing laboratory's facilities and qualifications of its technical personnel.
2. Indicating that following items meet specifications:
   a. Portland cement.
   b. Masonry cement.
   c. Mortar cement.
   d. Hydrated lime.
   e. Fine aggregate (sand).
   g. Color admixture.

C. Laboratory Test Reports:

1. Mortar, each type.
2. Admixtures.

D. Manufacturer's Literature and Data:

1. Cement, each kind.
2. Hydrated lime.
3. Admixtures.
4. Liquid acrylic resin.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.

B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

C40-04.....Organic Impurities in Fine Aggregates for Concrete

C91-07.....Masonry Cement

C109-05.....Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-MM Cube Specimens)

C144-04.....Aggregate for Masonry Mortar
C150-05.....Portland Cement
C207-06.....Hydrated Lime for Masonry Purposes
C270-07.....Mortar for Unit Masonry
C307-03.....Tensile Strength of Chemical - Resistant Mortar, Grouts, and Monolithic Surfacing
C321-00/R05.....Bond Strength of Chemical-Resistant Mortars
C348-02.....Flexural Strength of Hydraulic Cement Mortars
C595-07.....Blended Hydraulic Cement
C780-06.....Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C979-05.....Pigments for Integrally Colored Concrete
C1329-05.....Mortar Cement

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY MORTAR:

A. ASTM C144 and as follows:
   1. Light colored sand for mortar.
B. Test sand for color value in accordance with ASTM C40. Sand producing color darker than specified standard is unacceptable.

2.3 BLENDED HYDRAULIC CEMENT:

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

A. ASTM C91. Type N, S, or M.

2.5 MORTAR CEMEMT:

ASTM C1329, Type N, S or M.

2.6 PORTLAND CEMENT:

A. ASTM C150, Type I.

2.7 LIQUID ACRYLIC RESIN:

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.8 WATER:

Potable, free of substances that are detrimental to mortar, masonry, and metal.

2.9 POINTING MORTAR:

A. For Cast Stone or Precast Concrete: Proportion by volume; One part white Portland cement, two parts white sand, and 1/5 part hydrated lime.

2.10 MASONRY MORTAR:

A. Conform to ASTM C270.

B. Admixtures:

1. Do not use mortar admixtures and color admixtures unless approved by COTR.
2. Submit laboratory test report showing effect of proposed admixture on strength, water retention, and water repellency of mortar.
3. Do not use antifreeze compounds.

C. Colored Mortar:

1. Maintain uniform mortar color for exposed work throughout.
2. Match mortar color in approved sample and mock-up.
3. Color of mortar for exposed work in alteration work to match color of existing mortar.

D. Color Admixtures:

1. Proportion as specified by manufacturer.

2.11 HIGH BOND MORTAR:

A. Mixture by volume, one-part Portland cement, 1/4-part hydrated lime, three-parts sand, water, and liquid acrylic resin.

B. Mortar properties when tested in accordance with referenced specifications.

1. Compressive Strength, ASTM C109: Minimum 19,305 kPa (2800 psi), using 50 mm (2 inch) cubes.
2. Tensile Strength, ASTM C307: 3861 kPa Minimum (560 psi), using the 25mm (1 inch) briquettes.
3. Flexural Strength, ASTM C348: Minimum 6067 kPa (880 psi), using flexural bar.
4. Bond Strength, ASTM C321: Minimum 2965 kPa (430 psi), using crossed brick.

2.14 COLOR ADMIXTURE:

A. Pigments: ASTM C979.

B. Use mineral pigments only. Organic pigments are not acceptable.

C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

D. Provide full range color samples for Contracting Officer’s Technical Representative selection and approval.

PART 3 - EXECUTION

3.1 GENERAL:

a. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and

recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.2 MIXING:

A. Mix in a mechanically operated mortar mixer.
   1. Mix mortar for at least three minutes but not more than five minutes.
B. Measure ingredients by volume. Measure by the use of a container of known capacity.
C. Mix water with dry ingredients in sufficient amount to provide a workable mixture which will adhere to vertical surfaces of masonry units.
D. Discard mortar that has reached its initial set or has not been used within two hours.
E. Pointing Mortar:
   1. Mix dry ingredients with enough water to produce a damp mixture of workable consistency which will retain its shape when formed into a ball.
   2. Allow mortar to stand in dampened condition for one to 1-1/2 hours.
   3. Add water to bring mortar to a workable consistency prior to application.

3.3 MORTAR USE LOCATION:

A. Use Type S mortar for masonry containing vertical reinforcing bars (non-engineered), masonry below grade, masonry solar screens and setting cast stone.
B. For brick veneer over frame back up walls, use Type N portland cement-lime mortar or Type S masonry cement or mortar cement mortar.
C. Use Type N mortar for other masonry work, except as otherwise specified.
D. Use Type N mortar for tuck pointing work.
E. Use pointing mortar for items specified.
F. Cut Stone: Use mortar type as specified by cut stone manufacturer.

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SECTION 04 05 16
MASONRY GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION:

Section specifies grout materials and mixes.

1.2 RELATED WORK:

A. Grout used in Section:
   1. Section 03 45 00, PRECAST ARCHITECTURAL CONCRETE.
   2. Section 04 20 00, UNIT MASONRY.
   3. Section 04 72 00, CAST STONE MASONRY.

1.3 TESTS:

A. Test grout and materials specified.
B. Certified test reports.
C. Identify materials by type, brand name and manufacturer or by origin.
D. Do not use materials until laboratory test reports are approved by COTR.
E. After tests have been made and materials approved, do not change without additional test and approval of COTR.
F. Testing:
   1. Test materials proposed for use for compliance with specifications in accordance with test methods contained in referenced specifications and as follows:
   2. Grout:
      a. Test for compressive strength; ASTM C1019.
      b. Grout compressive strength of 2000 psi) at 28 days.
   3. Cement:
      a. Test for water soluble alkali (nonstaining) when nonstaining cement is specified.
      b. Nonstaining cement shall contain not more than 0.03 percent water soluble alkali.
   4. Sand: Test for deleterious substances, organic impurities, soundness and grading.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Certificates:
   1. Indicating that following items meet specifications:
      a. Portland cement.
      b. Masonry cement.
      c. Grout.

d. Hydrated lime.
e. Fine aggregate (sand).
f. Coarse aggregate for grout.
g. Color admixture.

C. Laboratory Test Reports:
1. Grout, each type.
2. Admixtures.

D. Manufacturer's Literature and Data:
1. Cement, each kind.
2. Hydrated lime.
3. Admixtures.
4. Liquid acrylic resin.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver masonry materials in original sealed containers marked with name of manufacturer and identification of contents.

B. Store masonry materials under waterproof covers on planking clear of ground, and protect damage from handling, dirt, stain, water and wind.

1.6 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

C40-04.....Organic Impurities in Fine Aggregates for Concrete
C91-05.....Masonry Cement
C150-05.....Portland Cement
C207-06.....Hydrated Lime for Masonry Purposes
C404-07.....Aggregate for Masonry Grout
C476-07.....Grout for Masonry
C595-08.....Blended Hydraulic Cement
C979-05.....Pigments for Integrally Colored Concrete
C1019-05.....Sampling and Testing Grout

PART 2 - PRODUCTS

2.1 HYDRATED LIME:

ASTM C207, Type S.

2.2 AGGREGATE FOR MASONRY GROUT:

ASTM C404, Size 8.

2.3 BLENDED HYDRAULIC CEMENT:

ASTM C595, Type IS, IP.

2.4 MASONRY CEMENT:

A. ASTM C91. Type N, S, or M.

2.5 PORTLAND CEMENT:

A. ASTM C150, Type I.

2.6 LIQUID ACRYLIC RESIN:

A formulation of acrylic polymers and modifiers in liquid form designed for use as an additive for mortar to improve physical properties.

2.7 WATER:

Potable, free of substances that are detrimental to grout, masonry, and metal.

2.8 GROUT:

A. Conform to ASTM C476 except as specified.

B. Grout type proportioned by volume as follows:

1. Fine Grout:
   a. Portland cement or blended hydraulic cement: one part.
   b. Hydrated lime: 0 to 1/10 part.
   c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
2. Coarse Grout:
   a. Portland cement or blended hydraulic cement: one part.
   b. Hydrated lime: 0 to 1/10 part.
   c. Fine aggregate: 2-1/4 to three times sum of volumes of cement and lime used.
   d. Coarse aggregate: one to two times sum of volumes of cement and lime used.
3. Sum of volumes of fine and coarse aggregates: Do not exceed four times sum of volumes of cement and lime used.

2.9 COLOR ADMIXTURE:

A. Pigments: ASTM C979.

B. Use mineral pigments only. Organic pigments are not acceptable.

C. Pigments inert, stable to atmospheric conditions, nonfading, alkali resistant and water insoluble.

PART 3 - EXECUTION

3.1 MIXING:

A. Mix in a mechanically operated grout mixer.
   1. Mix grout for at least five minutes.

B. Measure ingredients by volume. Measure by the use of a container of known capacity.

C. Mix water with grout dry ingredients in sufficient amount to bring grout mixture to a pouring consistency.

3.2 GROUT USE LOCATIONS:

A. Use fine grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is 50 mm (2 inches) or less.

B. Use either fine grout or coarse grout for filling wall cavities and cells of concrete masonry units where the smallest dimension is greater than 50 mm (2 inches).

C. Do not use grout for filling bond beam or lintel units.

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SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section specifies requirements for construction of masonry unit walls.

1.2 RELATED WORK

A. Masonry Mortaring: Section 040513

B. Masonry Grouting: Section 040516

C. Cut Stone: Section 044500

D. In-Wall Flashing and Moisture Control: Section 076000, FLASHING AND SHEET METAL.

E. Sealants and sealant installation: Section 079200, JOINT SEALANTS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES.

B. Samples:

1. Concrete masonry units, when exposed in finish work.
2. Anchors, and ties, one each and joint reinforcing 1200 mm (48 inches) long.
3. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Comply with ACI 315. Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
4. Certificates:
   a. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
   b. Testing laboratory facilities and qualifications of its principals and key personnel to perform tests specified.
5. Manufacturer's Literature and Data:
   a. Strip reinforcement.
   b. Reinforcing bars.

C. Shop Drawings:

1. Special masonry shapes.
2. Drawings, showing reinforcement, applicable dimensions and methods.

D. Certificates:
   1. Certificates signed by manufacturer, including name and address of contractor, project location, and the quantity, and date or dates of shipment of delivery to which certificate applies.
   2. Indicating that the following items meet specification requirements:
      a. Concrete masonry units
   3. Testing laboratories facilities and qualifications of its principals and key personnel to perform tests specified.

E. Manufacturer's Literature and Data:
   1. Anchors, ties, and reinforcement.
   2. Shear keys.
   3. Reinforcing bars.

1.4 WARRANTY

Warrant exterior masonry walls against moisture leaks and subject to terms of "Warranty of Construction" article in Section 00 72 00, GENERAL CONDITIONS, except that warranty period shall be five years.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A82-05.....Steel Wire, Plain, for Concrete Reinforcement.
A615/A615M-07.....Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
A675/A675M-03.....Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical PropertiesC34-03 Structural Clay Load-Bearing Wall Tile
C55-06.....Concrete Building Brick
C56-05.....Structural Clay Non-Load-Bearing Tile
C62-05.....Building Brick (Solid Masonry Units Made From Clay or Shale)
C67-07.....Sampling and Testing Brick and Structural Clay Tile
C90-06.....Load-Bearing Concrete Masonry Units
C126-99.....Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
C216-07.....Facing Brick (Solid Masonry Units Made From Clay or Shale)
C476-02.....Standard Specification for Grout for Masonry
C612-04.....Mineral Fiber Block and Board Thermal Insulation

C744-05.....Prefaced Concrete and Calcium Silicate Masonry Units.
D1056-07.....Flexible Cellular Materials - Sponge or Expanded Rubber
D2000-06.....Rubber Products in Automotive Applications
D2240-05.....Rubber Property - Durometer Hardness
D3574-05.....Flexible Cellular Materials-Slab, Bonded, and Molded Urethane Foams
F1667-05.....Fasteners: Nails, Spikes and Staples

C. Masonry Industry Council:
All Weather Masonry Construction Manual, 2000.

D. American Welding Society (AWS):
D1.4-05 Structural Welding Code – Reinforcing Steel.

E. Federal Specifications (FS):
FF-S-107C-00.....Screws, Tapping and Drive

F. Brick Industry Association - Technical Notes on Brick Construction (BIA):
11-1986.....Guide Specifications for Brick Masonry, Part I
11A–1988.....Guide Specifications for Brick Masonry, Part II
11B–1988.....Guide Specifications for Brick Masonry, Part III Execution
11C-1998.....Guide Specification for Brick Masonry Engineered Brick Masonry, Part IV
11D-1988.....Guide Specifications for Brick Masonry Engineered Brick Masonry, Part IV continued

G. Masonry Standards Joint Committee; Specifications for Masonry Structures (ACI 530.1-05/ASCE 6-05/TMS 602-99) (MSJC).

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Hollow and Solid Load-Bearing Concrete Masonry Units: ASTM C90.
1. Unit Weight: Normal weight.
2. Sizes: Modular

2.2 REINFORCEMENT:

A. Steel Reinforcing Bars: ASTM A615, deformed bars, 420 MPa (Grade 60) for bars No. 10 to No. 57 (No. 3 to No. 18), except as otherwise indicated.

2.3 ANCHORS, TIES, AND REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A615M, deformed bars, grade as shown.

B. Joint Reinforcement:
1. Form from wire complying with ASTM A82.
2. Galvanized after fabrication.

3. Width of joint reinforcement 40 mm (1-5/8 inches) less than nominal width of masonry wall or partition.
4. Cross wires welded to longitudinal wires.
5. Joint reinforcement at least 3000 mm (10 feet) in length.
6. Joint reinforcement in rolls is not acceptable.
7. Joint reinforcement that is crimped to form drip is not acceptable.
8. Maximum spacing of cross wires 400 mm (16 inches) to longitudinal wires.

C. Adjustable seismic Veneer Anchor for Masonry and Cut Stone at Columns and Walls:
1. Two piece, seismic adjustable anchor and tie.
a. Seismic adjustable Cavity Wall Ties:
1. The type of Seismic adjustable wall ties used at Contractor's option.
2. Two piece type permitting up to 40 mm (1-1/2 inch) adjustment.
3. Form ties from 5 mm (3/16 inch) diameter galvanized steel wire.
4. Form one piece to a rectangular shape 105 mm (4-1/8 inches) wide by length required to extend into the bed joint 50 mm (2 inches).
5. Form the other piece to a 75 mm (3 inch) long by 75 mm (3 inch) wide shape, having a 75 mm (3 inch) long bent section for engaging the 105 mm (4-1/8 inch) wide piece to form adjustable connection.

2.4 PREFORMED COMPRESSIBLE JOINT FILLER

A. Thickness and depth to fill the joint as specified.
B. Closed Cell Neoprene: ASTM D1056, Type 2, Class A, Grade 1, B2F1.
C. Non-Combustible Type: ASTM C612, Class 5, 1800 degrees F.

2.5 ACCESSORIES

A. Cell Vent DA1006 Dayton Superior 100% Recycled Polyester or an approved equal.
B. Box Board:
1. Mineral Fiber Board: ASTM C612, Class 1.
2. Thickness same as joint width.
3. Other spacing material having similar characteristics may be used subject to the COTR's approval.
C. Masonry Cleaner:
1. Detergent type cleaner selected for each type masonry used.
2. Acid cleaners are not acceptable.
3. Use soapless type specially prepared for cleaning brick.
D. Fasteners:

1. Concrete Nails: ASTM F1667, Type I, Style 11, 19 mm (3/4 inch) minimum length.
2. Masonry Nails: ASTM F1667, Type I, Style 17, 19 mm (3/4 inch) minimum length.
3. Screws: FS-FF-S-107, Type A, AB, SF thread forming or cutting.

PART 3 - EXECUTION

3.1 JOB CONDITIONS

A. Protection:

1. During freezing or near freezing weather, provide equipment and cover to maintain minimum of 40 degrees F and to protect work completed or in progress.

2. At end of working day, or during rainy weather, cover work exposed to weather with waterproof coverings, securely anchored extending at least 2 feet down both sides of walls.

3. Maintain materials and surrounding air to minimum 40 degrees F prior to, during, and 48 hours after completion of work.

4. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower freezing point of mortar by use of admixtures or antifreeze agents, and do no use calcium chloride in mortar or grout.

5. Do not build on frozen work; remove and replace stonework damaged by frost or freezing.

6. Protect base of wall from mud, dirt, mortar droppings, and other materials that will stain face, until final landscaping or other site work is completed.

7. Comply with MSJC and “Hot and Cold Weather Masonry Construction Manual”.

3.2 CONSTRUCTION TOLERANCES

A. Lay masonry units plumb, level and true to line within the tolerances as per MSJC requirements and as follows:

B. Maximum variation from plumb:

1. In 3000 mm (10 feet) - 6 mm (1/4 inch).
2. In 6000 mm (20 feet) - 10 mm (3/8 inch).
3. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).

C. Maximum variation from level:

1. In any bay or up to 6000 mm (20 feet) - 6 mm (1/4 inch).
2. In 12 000 mm (40 feet) or more - 13 mm (1/2 inch).

D. Maximum variation from linear building lines:

1. In any bay or up to 6000 mm (20 feet) - 13 mm (1/2 inch).
2. In 12 000 mm (40 feet) or more - 19 mm (3/4 inch).

E. Maximum variation in cross-sectional dimensions of columns and thickness of walls from dimensions shown:
   1. Minus 6 mm (1/4 inch).
   2. Plus 13 mm (1/2 inch).
F. Maximum variation in prepared opening dimensions:
   1. Accurate to minus 0 mm (0 inch).
   2. Plus 6 mm (1/4 inch).

3.3 INSTALLATION GENERAL

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.
B. Keep finish work free from mortar smears or spatters, and leave neat and clean.
C. Anchor masonry as specified in Paragraph, ANCHORAGE.
D. Tooling Joints:
   1. Do not tool until mortar has stiffened enough to retain thumb print when thumb is pressed against mortar.
   2. Tool while mortar is soft enough to be compressed into joints and not raked out.
   3. Finish joints in exterior face brick work with a jointing tool, and provide smooth, water-tight concave joint unless specified otherwise.
   4. Tool Exposed interior joints in finish work concave unless specified otherwise.
E. Before connecting new masonry with previously laid, remove loosened masonry or mortar, and clean and wet work in place as specified under wetting.
F. Temporary Formwork: Provide formwork and shores as required for temporary support of reinforced masonry elements.
G. Construct formwork to conform to shape, line and dimensions shown. Make sufficiently tight to prevent leakage of mortar, grout, or concrete (if any). Brace, tie and support as required to maintain position and shape during construction and curing of reinforced masonry.
H. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and all other reasonable temporary loads that may be placed on them during construction.
I. Allow not less than the following minimum time to elapse after completion of members before removing shores or forms, provided suitable curing conditions have been obtained during the curing period.
   1. 10 days for girders and beams.
   2. 7 days for slabs.

3. 7 days for reinforced masonry soffits.

3.4 ANCHORAGE

A. Veneer to Concrete Walls:

1. Anchor new masonry facing to existing concrete with seismic wall ties spaced at 400 mm, (16 inch) maximum vertical intervals, and at 600 mm (2 feet) maximum horizontal intervals – as per code. Fasten ties to concrete with power actuated fasteners or concrete nails.

B. Masonry Facing to Backup and Cavity Wall Ties:

1. Use individual ties.
2. Stagger seismic ties in alternate courses, and space at 400 mm (16 inches) maximum vertically, and 600 mm (2 feet) horizontally.
3. At openings, provide additional ties spaced not more than 900 mm (3 feet) apart vertically around perimeter of opening, and within 300 mm (12 inches) from edge of opening.

C. Masonry Furring:

1. Anchor masonry furring less than 100 mm (4 inches) nominal thick to concrete with seismic wall ties/anchors.
2. Space not over 600 mm (2 feet) on centers in both directions.

3.5 REINFORCEMENT

A. Joint Reinforcement:

1. Locate joint reinforcement in mortar joints at 400 mm (16 inch) maximum vertical intervals.
2. Additional strip reinforcement is required in mortar joints at both 200 mm (8 inches) and 400 (16 inches) above and below windows, doors, louvers and similar openings in masonry, except where other type anchors are required for anchorage of masonry to concrete structure.
3. Joint reinforcement is required in every course of stack bond CMU masonry.

B. Steel Reinforcing Bars:

1. Install in cells of hollow masonry units where required for vertical reinforcement and in bond beam units for lintels and bond beam horizontal reinforcement. Install in wall cavities of reinforced masonry walls where shown.
2. Use grade 40 bars if not specified otherwise.
3. Stack Bond:
   a. Locate reinforcement in vertical and horizontal joints as shown.
   b. Anchor vertical reinforcement in concrete foundation, and hold in place.
   c. Provide temporary bracing until masonry is completed.

3.6 EXPANSION AND CONTROL JOINTS.

A. Provide expansion and control joints where shown on drawings.

B. Keep joint free of mortar and other debris.
C. Where joints occur in stone masonry walls.
   1. Install preformed compressible joint filler in brick wythe.
   2. Install cross shaped shear keys in concrete masonry unit wythe with preformed compressible joint filler on each side of shear key.
   3. Install filler, backer rod, and sealant on exposed faces.
D. Use standard notched concrete masonry units (sash blocks) made in full and half-length units where shear keys are used to create a continuous vertical joint.
E. Interrupt steel joint reinforcement at expansion and control joints unless otherwise shown.
F. Fill opening in exposed face of expansion and control joints with sealant as specified in Section 07 92 00, JOINT SEALANTS.

3.7 EXPANSION AND SEISMIC JOINTS

A. Keep joint free of mortar. Remove mortar and other debris.
B. Install non-combustible, compressible type joint filler to fill space completely except where sealant is shown on joints in exposed finish work.
C. Where joints are on exposed faces, provide depth for backer rod and sealant as specified in Section 07 92 00, JOINT SEALANTS, unless shown otherwise.

3.8 ISOLATION SEAL

A. Insert in the separation, a continuous full width strip of non-combustible type compressible joint filler.
B. Where exposed in finish work, cut back filler material in the joint enough to allow for the joint to be filled with sealant material specified in Section 07 92 00, JOINT SEALANTS.

3.9 CUT STONE

A. Cavity Type Exterior Walls:
   1. Keep air space clean of mortar accumulations and debris.
      a. Clean cavity by use of hard rubber, wood or metal channel strips having soft material on sides contacting wythes.
      b. Lift strips with wires before placing next courses of horizontal joint reinforcement or individual ties or adjustable cavity wall ties.
      c. See also Section 044500 Cut Stone

3.10 CONCRETE MASONRY UNITS

A. Kind and Users:

1. Provide special concrete masonry shapes as required. Use solid concrete masonry units, where full units cannot be used, or where needed for anchorage of accessories.
2. Provide solid load-bearing concrete masonry units at jambs of openings in walls, where structural members impose loads directly on concrete masonry, and where shown.
3. Use concrete building brick only as filler in backup material where not exposed.

B. Laying:

1. Lay concrete masonry units with 10 mm (3/8 inch) joints, with a bond overlap of not less than 1/4 of the unit length, except where stack bond is required.
2. Do not wet concrete masonry units before laying.
3. Bond external corners of partitions by overlapping alternate courses.
4. Lay first course in a full mortar bed.
5. Set anchorage items as work progress.
6. Where ends of anchors, bolts, and other embedded items, project into voids of units, completely fill such voids with mortar or grout.
7. Provide a 6 mm (1/4 inch) open joint for caulking between abutting masonry partitions.
8. Lay concrete masonry units with full face shell mortar beds and fill head joint beds for depth equivalent to face shell thickness.
9. Lay concrete masonry units so that cores of units, that are to be filled with grout, are vertically continuous with joints of cross webs of such cores completely filled with mortar. Unobstructed core openings not less than 50 mm (2 inches) by 75 mm (3 inches).
10. Do not wedge the masonry against the steel reinforcing. Minimum 13 mm (1/2 inch) clear distance between reinforcing and masonry units.
11. Install deformed reinforcing bars of sizes shown.
12. Steel reinforcement, at time of placement, free of loose flaky rust, mud, oil, or other coatings that will destroy or reduce bond.
13. Steel reinforcement in place at the time of grouting.
14. Minimum clear distance between parallel bars: One bar diameter.
15. Hold vertical steel reinforcement in place by centering clips, caging devices, tie wire, or other approved methods, vertically at spacings noted.
16. Support vertical bars near each end and at intermediate intervals not exceeding 192 bar diameters.
17. Set horizontal reinforcement in a full bed of grout or concrete.

18. Splice reinforcement or attach reinforcement to dowels by placing in contact and wiring together or by placing the reinforcement within 1/5 of the required bar splice length.
19. Stagger splices in adjacent reinforcing bars. Lap reinforcing bars at splices a minimum of 40 bar diameters.
20. Grout cells of concrete masonry units, containing the reinforcing bars, solid as specified under grouting.
21. Cavity and strip horizontal reinforcement may be placed as the masonry work progresses.

3.11 POINTING

A. Fill joints with pointing mortar using rubber float trowel to rub mortar solidly into raked joints.
B. Wipe off excess mortar from joints of glazed masonry units with dry cloth.
C. Finish exposed joints in finish work with a jointing tool to provide a smooth concave joint unless specified otherwise – verify with owner.

3.12 PLACING REINFORCEMENT:

A. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on the Contract Drawings or final shop drawings, or bars with reduced cross-section due to excessive rusting or other causes.
B. Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 25 mm (1 inch), whichever is greater.

3.13 INSTALLATION OF REINFORCED CONCRETE UNIT MASONRY

A. Do not wet concrete masonry units (CMU).
B. Lay CMU units with full-face shell mortar beds. Fill vertical head joints (end joints between units) solidly with mortar from face of unit to a distance behind face equal to not less than the thickness of longitudinal face shells. Solidly bed cross-webs of starting courses in mortar. Maintain head and bed joint widths shown, or if not shown, provide 10 mm (3/8 inch) joints.
C. Where solid CMU units are shown, lay with full mortar head and bed joints.
D. Walls:
    1. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners

and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

2. Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

E. Grouting:

1. Use “Fine Grout” per ASTM C476 for filling spaces less than 100 mm (4 inches) in one or both horizontal directions.
2. Use “Coarse Grout” per ASTM C476 for filling 100 mm (4 inch) spaces or larger in both horizontal directions.
3. Grouting Technique: At the Contractor’s option, use either low-lift or high-lift grouting techniques subject to requirements which follow.

3.14 CLEANING AND REPAIR

A. General:

1. Clean exposed masonry surfaces on completion.
2. Protect adjoining construction materials and landscaping during cleaning operations.
3. Cut out defective exposed new joints to depth of approximately 19 mm (3/4 inch) and repoint.
4. Remove mortar droppings and other foreign substances from wall surfaces.

B. Concrete Masonry Units:

1. Immediately following setting, brush exposed surfaces free of mortar or other foreign matter.
2. Allow mud to dry before brushing.

3.15 WATER PENETRATION TESTING

A. Seven days before plastering or painting, in the presence of COTR, test solid exterior masonry walls for water penetration.

B. Direct water on masonry for a period of one hour at a time when wind velocity is less than five miles per hour.

C. Should moisture appear on inside of walls tested, make additional tests at other areas as directed by COTR.

D. Correct the areas showing moisture on inside of walls, and repeat test at repaired areas, to insure that moisture penetration has been stopped.

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SECTION 04 42 20
MARBLE NICHE COVERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section covers pre-drilled marble niche covers. No incising is required.

1.2 RELATED WORK

A. All fittings, mounting brackets, rosettes: Section 034550, PRECAST CONCRETE COLUMBARIUM UNITS.

1.3 SUBMITTALS

A. Submit in accordance with Section 013400, SAMPLES AND SHOP DRAWINGS.

B. Samples

1. **Note: Niche covers shall be furnished by the government but shall be installed by the contractor.** Two pieces of stone (12 inches wide, 12 inches long, 3/4 inch thick) shall be submitted to the COTR (typical) for color approval. Sample shall be clearly marked (on back) with indelible marker, showing contractor name and contract number. Submit the results of the required testing with this sample.
2. Within ten days of the approval of the first submittal, two sample niche covers, manufactured from the stone approved to be used, shall be submitted to the COTR for approval. Sample shall show the required quality of finish including the holes and shall be clearly marked (on back) with indelible marker, showing contractor name, contract number, quarry of origin and type of stone. These samples shall establish the minimum acceptable product for all deliverables under this contract. It will be the basis for comparison of all covers produced under this contract. Do not begin production until this submittal is approved.

C. Shop Drawings: Complete shop and erection drawing of all niche covers showing fabrication and anchorage of panels.

1.4 APPLICABLE PUBLICATIONS

A. Dimension Stones of the World, Volume II
Marble Institute of America, Inc.
28901 Clemens Road, Suite 100, Cleveland, OH 44145

B. ASTM, Section C97, C119, C179, C241 and C880

American Society for Testing Materials
100 Barr Harbor Drive, West Conshohocken, PA 19428

1.5 QUALITY ASSURANCE

A. Testing: **Note: Niche covers shall be furnished by the government and shall be installed by the contractor.** Stone supplied under this contract shall conform to the following specifications and physical requirements. Stone testing shall include the tests listed below and performed by an approved testing laboratory. Test results shall be submitted to the COTR for approval prior to the production of the sample niche covers. Testing is required only once and shall be from a representative sample of the quarry.

B. Abrasive hardness: Material shall have an abrasive hardness value (Ha) of not less than 10 when tested as specified in ASTM C-241.

C. Absorption: Material shall absorb not more than 0.15 percent of moisture by weight when tested for a 48-hour period as specified in ASTM C-97.

D. Material shall have a minimum compressive strength of 7500 psi or (5.2 kg/mm2) when tested as specified in ASTM C-170.

E. Modules of rupture: Material shall have a minimum modules of rupture of 1000 psi (or 0.70 kg/mm2) when tested as specified in ASTM C-170.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: **Note: Niche covers shall be furnished by the government and shall be installed by the contractor.**

1. Finished marble shall be carefully packed and loaded for shipment using all reasonable and customary precautions against shipping and handling damage or soiling. No material which may cause staining, discoloration or damage shall be used for blocking or packing.
2. Coordinate delivery of the niche covers with the COTR. All marble shall be received and unloaded at the site with care in handling to avoid damage or soiling. Unload, inspect, store, and protect niche covers after delivery to the job site and prior to installation.

B. Site Storage:

1. Store marble niche covers off ground with adequate protection to prevent chipping, breaking and other damage.
2. If marble is stored outside it shall be covered with non-staining waterproof paper, clean canvas or polyethylene.

C. Spares - All spares covers not used during installation are the property of the Government, and shall be turned over to the cemetery.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **Note: Niche covers shall be furnished by the government and shall be installed by the contractor.** Source of supply: All stones shall be obtained from quarries within the United States of America, having an adequate capacity and facilities to meet the specified requirements. Cutting and finishing shall be done by a manufacturer equipped to process the material promptly on order and in strict accord with these specifications. The contractor shall provide evidence to this effect to the COTR if requested.

B. Material shall conform to the definition of marble as contained in paragraph 2.1 of ASTM C-503. The overall whiteness of the marble exclusive of allowable coloration shall be no less than standard number 8.5 of the Munsell Neutral Value Scale, 32 Step Scale.

C. Material shall match the existing cemetery marble grave markers.

D. Quantity of Niche Covers: furnish sufficient numbers of niche covers to cover all of the new columbaria niches, plus a spare 100 niche covers.

E. Anti-graffiti coating system: Furnish and install a permanent two coat anti-graffiti coating system, matte type finish (non-gloss), designed to be applied on marble surfaces and to provide a minimum life, as indicated in the manufacturer’s literature, of 10 years. The coating system shall be clear

2.2 FABRICATION

A. **Note: Niche covers shall be furnished by the government and installed by the contractor.** Fabricate niche covers to size and thickness as indicated on drawings with drilled holes for anchorage.

B. Exposed surfaces shall have a honed 120 grit finish as approved by the COTR.

C. No patching of chipped edges or corners-is allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

B. Install niches cover plumb and level as shown so that exposed faces of niche covers lie in the same plane and that rows of niche covers align both horizontally and vertically. All stone veining shall be vertical. Tighten fasteners to achieve snug fit but do not over-tighten to the point where they may crack or break niche covers.
C. Contractor shall furnish to the COTR two (2) tools for removing and installing tamperproof, stainless steel bolts, which go through the rosettes to fasten the niche covers.
D. Niche covers and niche banks shall be protected from damage and soiling during the niche cover installation.

3.2 CLEANING AND PROTECTION

A. Marble shall be shop cleaned at time of fabrication. After installation, carefully clean the marble, removing all dirt, stains, and all other incidental defacements.
B. Stiff bristle fiber brushes may be used, but the use of wire brushes or of acid-type cleaning agents and other solutions which may cause discoloration or damage is expressly prohibited. Fabricator shall be consulted for recommendations before cleaners other than neutral detergents are used.
C. Protection of Finished Work: All marble work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

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SECTION 04 45 00
CUT STONE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Section includes:

1. Cut stone
2. Metal anchors
3. Sealing and anti-graffiti systems

1.2 RELATED WORK

A. Masonry Mortaring: Section 040513

B. Masonry Grouting: Section 040416

C. Unit Masonry: Section 042000

D. Joint Sealants: Section 079200

E. Anchors, etc.: Section 042000, UNIT MASONRY.

F. In-Wall Flashing and Moisture Control: Section 076000, FLASHING AND SHEET METAL.

1.3 SUBMITTALS

A. Submit in accordance with Section 013400, SAMPLES and SHOP DRAWINGS.

B. Cutting and setting drawings and indicating unit location number.

1. Indicate pertinent dimensioning, layout, anchorages, construction details, method of installation, adjacent construction, and jointing.
2. Indicate large scale details of inscriptions.

C. Submit stone supplier’s installation instructions and field erection drawings.

1. Submit manufacturer’s instructions for use of mortar color and admixtures.

D. Test reports: Prior to installation, submit information copies of test reports by approved independent testing laboratory as specified herein to COTR in triplicate.

E. Samples: Submit 12 inch by 12 inch size stone samples showing range of coloration, each different color, grade, texture, and finish of stonework. Color configuration to match existing cemetery entrance gate stone work color pattern.

1.4 QUALITY ASSURANCE

A. Comply with requirements of listed standards and industry standards unless otherwise indicated.

B. Obtain stone from single quarry with consistent color range and texture throughout work matching existing stone work.
C. Subcontract fabrication of stone to firm which has successfully fabricated stone similar to quality specified for period of not less than 5 years and is equipped to provide quantity shown.
D. Job mock-up: Prior to installation of stonework, erect sample wall panel mock-up showing proposed range of color pattern, stone size, pattern, texture, using materials, erection methods, jointing, and workmanship required for final work.
   1. Build mock-up at site where directed of full thickness and approximately 4 feet wide by 4 feet high. Construct back-up wall per wall type showing workmanship of all components.
   2. Obtain COTR’s acceptance of visual qualities of mock-up before start of stone work.

1.5 ENVIRONMENTAL REQUIREMENTS

A. During freezing or near freezing weather, provide equipment and cover to maintain minimum of 40 degrees F and to protect stone work completed or in progress.
B. At end of working day, or during rainy weather, cover stone work exposed to weather with waterproof coverings, securely anchored extending at least 2 feet down both sides of walls.
C. Maintain materials and surrounding air to minimum 40 degrees F prior to, during, and 48 hours after completion of work.
D. Do not use frozen materials or materials mixed or coated with ice or frost. Do not use salt to thaw ice in anchor holes or slots. Do not lower freezing point of mortar by use of admixtures or antifreeze agents, and do no use calcium chloride in mortar or grout.
E. Do not build on frozen work; remove and replace stonework damaged by frost or freezing.

1.6 PRODUCT DELIVERY

A. Protect stone during storage and construction against moisture, soiling staining, and physical damage.
B. Handle stone to prevent chipping, breakage, soiling, or other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials.
C. Store stone on wood skids or pallets covered with non-staining, waterproof membrane. Place and stack skids and stones to distribute weight evenly and to prevent breakage or cracking of stones. Protect stored stone from weather with waterproof, non-staining covers or enclosures, allow air to circulate around stones.

D. Protect mortar materials and stonework accessories from weather, moisture, and contamination with earth and other foreign materials.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to extent referenced. The publications are referenced in text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

C97.....Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone

C99.....Standard Test Method for Modulus of Rupture of Dimension Stone

C170.....Standard Test Method for Compressive Strength of Dimension Stone

C568.....Standard Specification for Limestone Dimension Stone

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Approved manufacturers meeting the requirements of ASTM C568.

B. Stone: Stone Veneer. Approved stone from local sources similar in color and characteristics to stone walls found within the grounds of the existing burial area at Chattanooga National Cemetery. Stone shall be free of cracks, seams, or imperfections which would impair the structural integrity of the material.

2.2 ACCESSORY MATERIALS

A. Anchors, Dowels, Ties, Cramps, and Supports: Type 304 stainless steel of sizes and configurations required for support of stone and applicable superimposed loads. – see also Section 042000 Masonry Units

B. Fasteners: Bolts, washers and nuts, galvanized Type 304 stainless steel.

C. Lifting Hooks where utilized: Removable type for panels in excess of 75 lbs.

D. Setting Buttons: Fiberglass of thickness required for joint size indicated to maintain uniform joint width.

1. Sealant: Comply with Section 079200 – Joint Sealants.

E. Water Repellant: Provide high performance water repellent for stone selected.

F. Anti-graffiti coating system: Furnish and install a permanent two coat anti-graffiti coating system, matte type finish (non-gloss), designed to be applied on cut stone surfaces and to provide a minimum life, as indicated in the manufacturer’s literature, of 10 years. The coating system shall be clear

2.3 STONE FABRICATION

A. Fabricate as shown and as detailed on reviewed shop drawings and in compliance with recommendations of applicable stone association.

B. Provide holes and sinkages cut or drilled for anchors, fasteners, supports and lifting devices, as indicated and required to secure stonework in place. Shape beds to fit supports.

C. Accurately cut, dress, drill, fit and finish stone work to shapes and sizes indicated. Cut edges square to face. Make arise straight, sharp, and true.

D. Cut numerical markers into face of stone by sandblasting where indicated on the drawings. All sandblasting work to be completed prior to setting stone – replace damaged materials with new.

PART 3 - EXECUTION

3.1 PREPARATION

A. Supply sufficient quantity of anchorages and direct correct placement.

B. Verify that items built-in under other sections are properly located and sized. Advise installers of other trades of specific requirements relating to placement and location of interrelated work. Exchange and coordinate shop drawings.

C. Establish lines, levels, and coursing. Protect from disturbance.

D. Clean stone prior to erection, leaving edges and surfaces free of dirt or foreign material. Do not use wire brushes or implements which mark or damage exposed surfaces. Do not wet expansion or control joints.

3.2 INSTALLATION

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

B. Erect stone in accordance with stone supplier’s instructions. Provide chases, reveals, reglets, openings, and other spaces as indicated or required for contiguous work.

B. Arrange stone pattern to provide consistent joint work throughout. Where open space between back of stone units and back-up or framing is indicated, keep cavity open, do not fill with mortar or grout.

C. Place setting buttons in full mortar setting bed to support stone over and establish joint dimension.

D. Set stone in full mortar setting bed to support stone over full bearing surface and to establish joint dimensions.

1. Point joints after setting by tooling to concave profile (verify profile with owner during job mock-up).

E. Shore up units until settling bed will maintain panel in position without movement.

F. Maintain uniform joint widths of 3/8 inch in exterior locations unless otherwise indicated.

G. Allowable tolerances:

1. Variation from Plumb: For lines, corners, and surfaces of walls, do not exceed 1/4 inch in 10 feet.
2. Maximum variation from plane of unit to adjacent unit: 1/32 inch.

I. Where stonework will contact ferrous metal surfaces concealed in back-up construction, apply heavy coat of bituminous paint on metal surfaces prior to setting of stone.

J. Cavity Construction: Keep open space between back of stone units and back-up or framing as shown, keep cavity open; do not fill with mortar or grout. See Section 07 60 00 Flashing and Sheet Metal

3.3 CUTTING AND FITTING

A. Obtain COTR’s concurrence prior to cutting or fitting any item not indicated on drawings. Do not impair appearance or strength of stone work.

3.4 SEALING

A. Apply water repellant solution to surface of stone after curing of mortar is complete, but not less than 28 days.

B. Apply sealant in strict accordance with the manufacturer’s current published application instructions. Manufacturer’s representative shall test, verify, and certify that application meets manufacturer’s requirements for performance.

C. Apply anti-graffiti coating system as per manufacturers specifications.

3.5 CLEANING

A. Remove excess mortar and sealant upon completion of work. Remove broken, chipped, or stained units. Re-point defective joints.

B. Clean soiled surfaces using solution which will not harm stone, joint materials, or adjacent surfaces. Consult stone supplier for recommended type.

C. Use non-metallic tools in cleaning operations Advise Contractor of proper procedures required to protect stonework during construction.

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SECTION 04 72 00
CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section specifies manufactured concrete units to simulate a natural stone.

C. Installation of cast stone units.

1.2 RELATED WORK

A. Setting and pointing mortar: Section 04 05 13, MASONRY MORTAR.

B. Joint sealant and application: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Cast stone, sample panel, size 100 by 300 by 300 mm (4 by 12 by 12 inches) each color and finish.
2. Show finish on two 100 mm (4-inch) edges and 300 by 300 mm (12 by 12 inch) surface.

C. Shop Drawings:

1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
2. Setting drawings with setting mark.

D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification.

E. Submit manufacturers test results of cast stone previously made by manufacturer.

F. Laboratory Data: Description of testing laboratories facilities and qualifications of its principals and key personnel.

G. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store cast stone under waterproof covers on planking clear of ground.

B. Protect from handling, dirt, stain, and water damage.

C. Mark production units with the identification marks as shown on the shop drawings.

D. Package units and protect them from staining or damage during shipping and storage.

E. Provide an itemized list of product to support the bill of lading.

1.5 WARRANTY

Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction" article in Section 00 72 00, GENERAL CONDITIONS, except that warranty period shall be five years.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Cast Stone Institute Technical Manual 04720 and Cast Stone Institute standard specification (2004).

C. American Society for Testing and Materials (ASTM):

A167-99 (2004).....Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A185-02.....Steel, Welded Wire Fabric, Plain for Concrete

A615/A615M-04b.....Deformed and Plain Billet-Steel Bars for Concrete

C33-03.....Concrete Aggregates

C150-04ae1.....Portland Cement

C503-03.....Marble Dimension Stone (Exterior)

C568-03.....Limestone Dimension Stone

C615-03.....Granite Dimension Stone

C616-03.....Quartz-Based Dimension Stone

C979-99.....Pigments for Integrally Colored Concrete

C1194-03.....Compressive Strength of Architectural Cast Stone

C1195-03.....Absorption of Architectural Cast Stone

C3164-03.....Standard Specification for Architectural Cast Stone.

D2244-02e1.....Test method for calculation of color differences from instrumentally measured color coordinates.

1.7 QUALITY ASSURANCE

A. Manufacturer: Must have ten (10) years minimum continuous operating experience and have facilities for manufacturing cast stone as described herein. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of cast stone required in accordance with the project schedule.

B. Manufacturer: Must be a member of the Cast Stone Institute.

C. Manufacturer: Must have a certified plant (certification by the Cast Stone Institute).

D. Stone setter: Must have ten (10) years experience setting cast or natural building stone.

E. Testing: One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14 m 3) delivered to the job:

1. Three (3) field cut cube specimens from each of these sample shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318
2. Three (3) field cut cube specimens from each of these samples shall have and average maximum cold-water absorption of 6%.
3. Field specimens shall be tested in accordance with ASTMC 1194 and C 1195.
4. Manufacturer shall submit a written list of projects similar and at least three (3) years of age, along with owner, architect and contractor references.

1.8 MANUFACTURING TOLERANCES

A. Cross section dimensions shall not deviate by more than + 1/8 in. (3 mm) from approved dimension.

B. Length of units shall not deviate by more than length /360 or + 1/8 in. (3mm), whichever is greater, not to exceed + 1/4 in (6 mm). Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.

C. Warp bow or twist of units shall not exceed length/360 or + 1/8 in. (3 mm), whichever is greater.

D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – On formed sides of unit, 1/8 in (3 mm), on unformed sides of unit, 3/8 in (9 mm) maximum deviation.

1.9 MOCK-UP

Provide full size unit(s) for use in construction of sample capstone – for approval. The mock-up becomes the standard of workmanship for the project. Coordinate mock-up with Columbarium Niche Unit bearing requirements.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CAST STONE

A. Comply with ASTM C 1364

B. Physical properties: Provide the following:

1. Compressive Strength – ASTM C 1194: 6,500 psi (45 Mpa) minimum for products at 28 days.
2. Absorption – ASTM C 1195: 6% maximum by the cold water method, or 10% maximum by the boiling method for products as 28 days.

3. Air Content – ASTM C173 or C231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for vibrant dry tamp (VDT) products.
4. Freeze thaw - ASTM C 1364L The cumulative percent weight loss (CPWL) shall be less than 5% after 300 cycles of freezing and thawing.
5. Linear Shrinkage - ASTM C 426L Shrinkage shall not exceed 0.065%.

C. Job site testing – One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14m3) delivered to the job site:
1. Three (3) field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318.
2. Three (3) field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6%.
3. Field specimens shall be tested in accordance with ASTM C 1194 and C 1195.

2.2 RAW MATERIALS

A. Portland cement – Type I or Type III, white and/or grey, ASTM C 150.
B. Coarse aggregates – Granite, quartz or limestone, ASTM C 33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
C. Fine aggregates – Manufactured or natural sands, ASTM C 33, except for gradation.
D. Colors – Inorganic iron oxide pigments, ASTM C 979 except that carbon black pigments shall not be used.
E. Admixtures- Comply with the following:
1. ASTM C 260 for air-entraining admixtures.
2. ASTM C 494/C 495 M Types A-G for water reducing, retarding, accelerating and high range admixtures.
3. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
4. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
5. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
F. Water – Potable
G. Reinforcing bars:

1. ASTM A 615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in. (37 mm).
2. Welded Wire Fabric: ASTM A 185 where applicable for wet cast units.

H. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as galvanized steel, brass, or stainless steel Type 302 or 304.

2.3 COLOR AND FINISH

A. Provide color samples (full range) for Contracting Officer's Technical Representative selection and approval.

B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. (0.8 mm) and the density of such voids shall be less than 3 occurrences per any 1 in2 (25mm2) and not obvious under direct daylight illumination at a 5 ft. (1.5m)distance.

C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3m) distance.

D. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.

E. Total color difference – not greater than 6 units.

F. Total hue difference-not greater than 2 units.

G. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 6-ft distance.

H. Cut numerical markers into face of cast stone by sandblasting where indicated on the drawings. All sandblasting work to be completed prior to setting cast stone – replace damaged materials with new prior to placement on columbarium niche unit wall.

I. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.

J. Remove cement film, if required, from exposed surfaces prior to packaging for shipment.

2.4 REINFORCING

A. Reinforce the units as required by the manufacturer and for safe handling and structural stress.
   1. Minimum reinforcing shall be 0.25 percent of the cross section area.

B. Reinforcement shall be non-corrosive where faces exposed to weather are covered with less than 1.5in. (38 mm) of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.

2.5 CURING

Cure units in a warm curing chamber 1000 F (37.80 C) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 700F (21.10C) for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350-degree-days (i.e. 7 days @ 500F (100C) or 5 days @ 700F (210C) prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

B. Installing contractor shall check cast stone materials for fit and finish prior to installation and marker sandblasting. Do not set unacceptable units.

C. Installing contractor and cast stone manufacturer to verify and coordinate with Columbarium Niche Unit manufacturer that cast stone capstone loads and bearing points fall within Columbarium niche unit requirements for live loads and dead loads - verify and coordinate prior to fabrication.

3.2 SETTING TOLERANCES

A. Comply with Cast Stone Institute [SM] Technical Manual.

B. Set stones 1/8 in. (3 mm) or less, within the plane of adjacent units.

C. Joints, plus – 1/6 in. (1.5 mm), minus – 1/8 in. (3 mm).

3.3 JOINTING

A. Joint size:

1. At stone/stone joints in vertical position 3/8 in.
2. Stone/stone joint exposed on top 3/8 in. (.5 mm).

B. Joint Materials:

1. Mortar, Type N, ASTM C 270.
2. Use a full bed of mortar at all bed joints.
3. Flush vertical joints full with mortar.
4. Leave all joints with exposed tops or under relieving angles open for sealant.
5. Leave head joints in coping and projecting components open for sealant.

B. Location of joints:

1. As shown on shop drawings.
2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Drench units with clean water prior to setting.

B. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

C. Set units in full bed of mortar, unless otherwise detailed and/or recommended by the Columbarium Niche Unit manufacturer. Coordinate bearing point locations with the Columbarium Niche Unit Manufacturer. Verify and coordinate live load and dead load requirements of the Columbarium Niche Unit prior to fabrication of Cast Stone capstone.

D. Rake mortar joints 3/4 in. (18 mm) in. for pointing.

E. Remove excess mortar from unit faces immediately after setting.

F. Tuck point unit joints to a slight concave profile – verify with owner.

3.5 JOINT PROTECTION

A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.

B. Prime ends of units, insert properly sized backing rod and install required sealant.

3.6 REPAIR AND CLEANING

A. Repair chips with touchup materials furnished by manufacturer.

B. Saturate units to be cleaned prior to applying an approved masonry cleaner.

C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute.

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SECTION 04 72 00
CAST STONE MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section specifies manufactured concrete units to simulate a natural stone.

C. Installation of cast stone units.

1.2 RELATED WORK

A. Setting and pointing mortar: Section 04 05 13, MASONRY MORTAR.

B. Joint sealant and application: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples:

1. Cast stone, sample panel, size 100 by 300 by 300 mm (4 by 12 by 12 inches) each color and finish.
2. Show finish on two 100 mm (4-inch) edges and 300 by 300 mm (12 by 12 inch) surface.

C. Shop Drawings:

1. Cast stone showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
2. Setting drawings with setting mark.

D. Certificates: Test results indicating that the cast stone meets specification requirements and proof of plant certification.

E. Submit manufacturers test results of cast stone previously made by manufacturer.

F. Laboratory Data: Description of testing laboratories facilities and qualifications of its principals and key personnel.

G. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store cast stone under waterproof covers on planking clear of ground.

B. Protect from handling, dirt, stain, and water damage.

C. Mark production units with the identification marks as shown on the shop drawings.

D. Package units and protect them from staining or damage during shipping and storage.

E. Provide an itemized list of product to support the bill of lading.

1.5 WARRANTY

Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction" article in Section 00 72 00, GENERAL CONDITIONS, except that warranty period shall be five years.

1.6 APPLICABLE PUBLICATIONS

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. Cast Stone Institute Technical Manual 04720 and Cast Stone Institute standard specification (2004).

C. American Society for Testing and Materials (ASTM):

A167-99 (2004).....Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A185-02.....Steel, Welded Wire Fabric, Plain for Concrete

A615/A615M-04b.....Deformed and Plain Billet-Steel Bars for Concrete

C33-03.....Concrete Aggregates

C150-04ae1.....Portland Cement

C503-03.....Marble Dimension Stone (Exterior)

C568-03.....Limestone Dimension Stone

C615-03.....Granite Dimension Stone

C616-03.....Quartz-Based Dimension Stone

C979-99.....Pigments for Integrally Colored Concrete

C1194-03.....Compressive Strength of Architectural Cast Stone

C1195-03.....Absorption of Architectural Cast Stone

C3164-03.....Standard Specification for Architectural Cast Stone.

D2244-02e1.....Test method for calculation of color differences from instrumentally measured color coordinates.

1.7 QUALITY ASSURANCE

A. Manufacturer: Must have ten (10) years minimum continuous operating experience and have facilities for manufacturing cast stone as described herein. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of cast stone required in accordance with the project schedule.

B. Manufacturer: Must be a member of the Cast Stone Institute.

C. Manufacturer: Must have a certified plant (certification by the Cast Stone Institute).

D. Stone setter: Must have ten (10) years experience setting cast or natural building stone.

E. Testing: One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14 m 3) delivered to the job:

1. Three (3) field cut cube specimens from each of these sample shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318
2. Three (3) field cut cube specimens from each of these samples shall have and average maximum cold-water absorption of 6%.
3. Field specimens shall be tested in accordance with ASTMC 1194 and C 1195.
4. Manufacturer shall submit a written list of projects similar and at least three (3) years of age, along with owner, architect and contractor references.

1.8 MANUFACTURING TOLERANCES

A. Cross section dimensions shall not deviate by more than + 1/8 in. (3 mm) from approved dimension.

B. Length of units shall not deviate by more than length /360 or + 1/8 in. (3mm), whichever is greater, not to exceed + 1/4 in (6 mm). Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.

C. Warp bow or twist of units shall not exceed length/360 or + 1/8 in. (3 mm), whichever is greater.

D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features – On formed sides of unit, 1/8 in (3 mm), on unformed sides of unit, 3/8 in (9 mm) maximum deviation.

1.9 MOCK-UP

Provide full size unit(s) for use in construction of sample capstone – for approval. The mock-up becomes the standard of workmanship for the project. Coordinate mock-up with Columbarium Niche Unit bearing requirements.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CAST STONE

A. Comply with ASTM C 1364

B. Physical properties: Provide the following:

1. Compressive Strength – ASTM C 1194: 6,500 psi (45 Mpa) minimum for products at 28 days.
2. Absorption – ASTM C 1195: 6% maximum by the cold water method, or 10% maximum by the boiling method for products as 28 days.

3. Air Content – ASTM C173 or C231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for vibrant dry tamp (VDT) products.
4. Freeze thaw - ASTM C 1364L The cumulative percent weight loss (CPWL) shall be less than 5% after 300 cycles of freezing and thawing.
5. Linear Shrinkage - ASTM C 426L Shrinkage shall not exceed 0.065%.

C. Job site testing – One (1) sample from production units may be selected at random from the field for each 500 cubic feet (14m3) delivered to the job site:
1. Three (3) field cut cube specimens from each of these samples shall have an average minimum compressive strength of not less than 85% with no single specimen testing less than 75% of design strength as allowed by ACI 318.
2. Three (3) field cut cube specimens from each of these samples shall have an average maximum cold-water absorption of 6%.
3. Field specimens shall be tested in accordance with ASTM C 1194 and C 1195.

2.2 RAW MATERIALS

A. Portland cement – Type I or Type III, white and/or grey, ASTM C 150.
B. Coarse aggregates – Granite, quartz or limestone, ASTM C 33, except for gradation, and are optional for the vibrant dry tamp (VDT) casting method.
C. Fine aggregates – Manufactured or natural sands, ASTM C 33, except for gradation.
D. Colors – Inorganic iron oxide pigments, ASTM C 979 except that carbon black pigments shall not be used.
E. Admixtures- Comply with the following:
1. ASTM C 260 for air-entraining admixtures.
2. ASTM C 494/C 495 M Types A-G for water reducing, retarding, accelerating and high range admixtures.
3. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
4. ASTM C 618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
5. ASTM C 989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
F. Water – Potable
G. Reinforcing bars:

1. ASTM A 615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 in. (37 mm).
2. Welded Wire Fabric: ASTM A 185 where applicable for wet cast units.

H. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as galvanized steel, brass, or stainless steel Type 302 or 304.

2.3 COLOR AND FINISH

A. Provide color samples (full range) for Contracting Officer's Technical Representative selection and approval.

B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 in. (0.8 mm) and the density of such voids shall be less than 3 occurrences per any 1 in2 (25mm2) and not obvious under direct daylight illumination at a 5 ft. (1.5m)distance.

C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft (3m) distance.

D. ASTM D 2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.

E. Total color difference – not greater than 6 units.

F. Total hue difference-not greater than 2 units.

G. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under direct daylight illumination from a 6-ft distance.

H. Cut numerical markers into face of cast stone by sandblasting where indicated on the drawings. All sandblasting work to be completed prior to setting cast stone – replace damaged materials with new prior to placement on columbarium niche unit wall.

I. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.

J. Remove cement film, if required, from exposed surfaces prior to packaging for shipment.

2.4 REINFORCING

A. Reinforce the units as required by the manufacturer and for safe handling and structural stress.
   1. Minimum reinforcing shall be 0.25 percent of the cross section area.

B. Reinforcement shall be non-corrosive where faces exposed to weather are covered with less than 1.5in. (38 mm) of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.

2.5 CURING

Cure units in a warm curing chamber 1000 F (37.80 C) at 95 percent relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 700F (21.10C) for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350-degree-days (i.e. 7 days @ 500F (100C) or 5 days @ 700F (210C) prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets or curing compounds after casting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

B. Installing contractor shall check cast stone materials for fit and finish prior to installation and marker sandblasting. Do not set unacceptable units.

C. Installing contractor and cast stone manufacturer to verify and coordinate with Columbarium Niche Unit manufacturer that cast stone capstone loads and bearing points fall within Columbarium niche unit requirements for live loads and dead loads - verify and coordinate prior to fabrication.

3.2 SETTING TOLERANCES

A. Comply with Cast Stone Institute [SM] Technical Manual.

B. Set stones 1/8 in. (3 mm) or less, within the plane of adjacent units.

C. Joints, plus – 1/6 in. (1.5 mm), minus – 1/8 in. (3 mm).

3.3 JOINTING

A. Joint size:

1. At stone/stone joints in vertical position 3/8 in.
2. Stone/stone joint exposed on top 3/8 in. (.5 mm).

B. Joint Materials:

1. Mortar, Type N, ASTM C 270.
2. Use a full bed of mortar at all bed joints.
3. Flush vertical joints full with mortar.
4. Leave all joints with exposed tops or under relieving angles open for sealant.
5. Leave head joints in coping and projecting components open for sealant.

B. Location of joints:

1. As shown on shop drawings.
2. At control and expansion joints unless otherwise shown.

3.4 SETTING

A. Drench units with clean water prior to setting.

B. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

C. Set units in full bed of mortar, unless otherwise detailed and/or recommended by the Columbarium Niche Unit manufacturer. Coordinate bearing point locations with the Columbarium Niche Unit Manufacturer. Verify and coordinate live load and dead load requirements of the Columbarium Niche Unit prior to fabrication of Cast Stone capstone.

D. Rake mortar joints 3/4 in. (18 mm) in. for pointing.

E. Remove excess mortar from unit faces immediately after setting.

F. Tuck point unit joints to a slight concave profile – verify with owner.

3.5 JOINT PROTECTION

A. Comply with requirements of Section 07 92 00, JOINT SEALANTS.

B. Prime ends of units, insert properly sized backing rod and install required sealant.

3.6 REPAIR AND CLEANING

A. Repair chips with touchup materials furnished by manufacturer.

B. Saturate units to be cleaned prior to applying an approved masonry cleaner.

C. Consult with manufacturer for appropriate cleaners.

3.7 INSPECTION AND ACCEPTANCE

Inspect finished installation according to Bulletin #36 published by the Cast Stone Institute.

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SECTION 07 60 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Formed sheet metal work for flashing and insulated expansion joint covers are specified in this section.

1.2 RELATED WORK

A. Sealant compound and installation: Section 07 92 00, JOINT SEALANTS.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

Flashings

Expansion joints

C. Manufacturer's Literature and Data:

Thru wall flashing

Nonreinforced, elastomeric sheeting

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below for a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A167-99(R 2004).....Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A653/A653M-07.....Steel Sheet Zinc-Coated (Galvanized) or Zinc Alloy Coated (Galvanized) by the Hot- Dip Process

B32-04.....Solder Metal

B209-07.....Aluminum and Aluminum-Alloy Sheet and Plate

B370-03.....Copper Sheet and Strip for Building Construction

D146 .....Standard Test Methods for Sampling and Testing Bitumen Saturated Felts and Woven Fabrics for Roofing and Waterproofing

D173-03.....Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing

D412 .....Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

D570 .....Standard Test Method for Water Absorption of Plastics

D903 .....Standard Test Method for Peel and Stripping Strength of Adhesive Bonds

D1187-97 (R2002).....Asphalt Base Emulsions for Use as Protective Coatings for Metal

D1784-07.....Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

D3656-07.....Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

D4586-07.....Asphalt Roof Cement, Asbestos Free

D1876 .....Standard Test Method for Peel Resistance of Adhesive

D4263 .....Standard Test Method for Indicating Moisture Content by Plastic sheet Method

E96 .....Standard Test Methods for Water Vapor Transmission of Materials

E154 .....Standard Test Methods for Water Vapor Retarders used in Contact with Earth under Concrete Slabs, on Walls or as Ground Cover

C. American National Standards Institute/Single Ply Roofing Institute (ANSI/SPRI):

ES-1-2003.....Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual (2003 Edition).

E. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-505-88.....Metal Finishes Manual

F. American Architectural Manufacturers Association (AAMA):

605-98.....Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions Panels

G. Federal Specification (Fed. Spec):

A-A-1925A.....Shield, Expansion; (Nail Anchors)

UU-B-790A.....Building Paper, Vegetable Fiber

H. International Building Code (IBC):

2007 Edition

1.5 PERFORMANCE REQUIREMENTS

A. Provide a membrane constructed to perform as a through-wall flashing durably integrated with the wall assembly's water resistive barrier and cavity drainage system. The installed through-wall flashing shall perform as a liquid water drainage plane to discharge incidental condensation or water penetration to the exterior through the cavity drainage system.

REQUIREMENT	RESULT	TEST METHOD
Tensile Strength	Not less than 900 psi	ASTM D-412
Puncture Resistance	Not less than 80 lb.	ASTM E 154
Low Temperature Flexibility	Unaffected at minus 25 degrees F, 0.063 inch mandrel	ASTM D 146
Peel Adhesion	Not less than 5 lb per inch width on concrete prepared with contact adhesive	ASTM D 903
Lap Adhesion	Not less than 5 lb. per inch width	ASTM D 1876
Water Vapor Permeance	Not more than 0.05 Perm	ASTM E-96, Method B
Water Absorption	Not more than 0.12 percent by weight	ASTM D 570

PART 2 - PRODUCTS

2.1 MATERIALS

A. Solder: ASTM B32; flux type and alloy composition as required for use with metals to be soldered.

B. Stainless Steel: ASTM A167, Type 302B, dead soft temper.

C. Nonreinforced, Elastomeric Sheeting: Elastomeric substances reduced to thermoplastic state and extruded into continuous homogenous sheet. Sheeting shall have not less than 7 MPa (1,000 psi) tensile strength and not more than seven percent tension-set at 50 percent elongation when tested in accordance with ASTM D412. Sheeting shall show no cracking or flaking when bent through 180 degrees over a 1 mm (1/32

inch) diameter mandrel and then bent at same point over same size mandrel in opposite direction through 360 degrees at temperature of -30°C (-20 °F), self adhering through wall flashing.

D. Bituminous Paint: ASTM D1187, Type I.

E. Fasteners:

1. Use copper, copper alloy, bronze, brass, or stainless steel for copper and copper clad stainless steel, and stainless steel for stainless steel and aluminum alloy. Use galvanized steel or stainless steel for galvanized steel.

2. Nails:

c. Minimum diameter for stainless steel nails: 2 mm (0.095 inch) and annular threaded.

d. Length to provide not less than 22 mm (7/8 inch) penetration into anchorage.

3. Expansion Shields: Fed Spec A-A-1925A.

F. Sealant: As specified in Section 07 92 00, JOINT SEALANTS for exterior locations.

G. Termination Bar: Dayton Superior DA 1510, Stainless Steel, 8” thick, 1 1/2” wide, holes 5/16” at 8” on center, or an approved equal.

H. Mortar Mesh: Dayton Superior DA 1008 – 100% Recycled Polyester, or an approved equal.

I. Vent: Dayton Superior DA 1006 Cell Vent, or an approved equal.

J. Self-Adhering Membrane at Top of Columbarium: 40 mil Carlisle Flexphalt or an approved equal.

K. Tube Vent: Dayton Superior DA 1005 Tube Vent, or an approved equal.

2.2 FABRICATION, GENERAL

A. Expansion and Contraction Joints:

1. Fabricate in accordance with the Architectural Sheet Metal Manual recommendations for expansion and contraction of sheet metal work in continuous runs.

2. Space joints as shown or as specified.

3. Fabricate slip-type or loose locked joints and fill with sealant unless otherwise specified.

B. Edges:

1. Edges of flashings concealed in masonry joints opposite drain side shall be turned up 6 mm (1/4 inch) to form dam, unless otherwise specified or shown otherwise.

2. Finish exposed edges of flashing with a 6 mm (1/4 inch) hem formed by folding edge of flashing back on itself when not hooked to edge strip or cleat. Use 6 mm (1/4 inch) minimum penetration beyond wall face with drip for through-wall flashing exposed edge.

C. Metal Options:

1. Where options are permitted for different metals use only one metal throughout.
2. Stainless steel may be used in concealed locations for fasteners of other metals exposed to view.

2.3 FINISH

A. Steel and Galvanized Steel:

1. Finish painted unless specified as prefinished item.

PART 3 - EXECUTION

3.1 GENERAL

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions affecting installation of the through-wall flashing and accessory products for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing Work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Concrete shall be cured for a minimum of seven days.

C. Surfaces shall be sound, dry and free of oil, grease, dirt, excess mortar or other contaminants.

D. Surfaces shall be supported and flush at joints without large voids or sharp protrusions.

E. Inform COTR in writing of anticipated problems applying Product over substrate.

3.3 THROUGH-WALL FLASHING

A. General:

1. Install continuous through-wall flashing between top of concrete foundation walls and bottom of columns; under masonry, concrete, or stone copings and elsewhere as shown.
2. Cut and fit to cover inside and outside corners.
3. Turn up ends at discontinuities 1 inch minimum to form end dams.

4. Roll firmly to substrate with hand roller tool. Roll laps firmly in perpendicular direction to terminating edge.
5. Seal end laps, cut edges and around penetrations with Mastic.
6. Product shall extend vertically up the back-up wall 8 inches minimum.
7. Keep product minimum 1/4 minimum from finished exterior. Keep edge from contacting visible sealant.
8. Lap end joints at least two corrugations, but not less than 100 mm (4 inches). Seal laps with sealant.
9. Where dowels, reinforcing bars and fastening devices penetrate flashing, seal penetration with sealing compound. Sealing compound is specified in Section 07 92 00, JOINT SEALANTS.
10. Coordinate with other work to set in a bed of mortar above and below flashing so that total thickness of the two layers of mortar and flashing are same as regular mortar joint.
11. At concrete backing, extend flashing to termination bar as indicated on drawings. Seal termination bar to substrate with Mastic.

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SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Section covers all sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

1.2 RELATED WORK:

A. Sealing of site work concrete paving: Section 32 05 23, CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS.

B. Masonry control and expansion joint: Section 04 20 00, UNIT MASONRY.

C. Sealing of cut stone joints: Section 04 45 00, CUT STONE.

D. Sealing of cast stone joints: Section 04 72 00, CAST STONE.

E. Sealing of concrete: Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.3 QUALITY CONTROL:

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results from a qualified testing agency based on testing current sealant formulations within a 12-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI’s Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.

4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates in accordance with sealant manufacturer’s recommendations:
   1. Locate test joints where indicated or, if not indicated, as directed by Contracting Officer.
   2. Conduct field tests for each application indicated below:
      a. Each type of elastomeric sealant and joint substrate indicated.
      b. Each type of non-elastomeric sealant and joint substrate indicated.
   3. Notify COTR seven days in advance of dates and times when test joints will be erected.
   4. Arrange for tests to take place with joint sealant manufacturer’s technical representative present.

E. VOC: Acrylic latex and Silicon sealants shall have less than 50g/l VOC content.

F. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this section.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's installation instructions for each product used.

C. Cured samples of exposed sealants for each color where required to match adjacent material.

D. Manufacturer's Literature and Data:
   1. Caulking compound
   2. Primers
   3. Sealing compound, each type, including compatibility when different sealants are in contact with each other.

1.5 PROJECT CONDITIONS:

A. Environmental Limitations:
   1. Do not proceed with installation of joint sealants under following conditions:

a. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4.4 °C (40 °F).

b. When joint substrates are wet.

B. Joint-Width Conditions:

1. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions:

1. Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.6 DELIVERY, HANDLING, AND STORAGE:

A. Deliver materials in manufacturers' original unopened containers, with brand names, date of manufacture, shelf life, and material designation clearly marked thereon.

B. Carefully handle and store to prevent inclusion of foreign materials.

C. Do not subject to sustained temperatures exceeding 5° C (40° F) or less than 32° C (90° F).

1.7 DEFINITIONS:

A. Definitions of terms in accordance with ASTM C717 and as specified.

B. Back-up Rod: A type of sealant backing.

C. Bond Breakers: A type of sealant backing.

D. Filler: A sealant backing used behind a back-up rod.

1.8 WARRANTY:

A. Warranty exterior sealing against leaks, adhesion, and cohesive failure, and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be extended to two years.

B. General Warranty: Special warranty specified in this Article shall not deprive Government of other rights Government may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

1.9 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Society for Testing and Materials (ASTM):

C509-06.....Elastomeric Cellular Preformed Gasket and Sealing Material.

C612-04.....Mineral Fiber Block and Board Thermal Insulation.

C717-07.....Standard Terminology of Building Seals and Sealants.

C834-05.....Latex Sealants.

C919-02.....Use of Sealants in Acoustical Applications.

C920-05.....Elastomeric Joint Sealants.

C1021-08.....Laboratories Engaged in Testing of Building Sealants.

C1193-05.....Standard Guide for Use of Joint Sealants.

C1330-02 (R2007).....Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

D1056-07.....Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.

E84-08.....Surface Burning Characteristics of Building Materials.

C. Sealant, Waterproofing and Restoration Institute (SWRI).
The Professionals' Guide

PART 2 - PRODUCTS

2.1 SEALANTS:

A. S-1:

1. ASTM C920, polyurethane or polysulfide.
2. Type M.
3. Class 25.
4. Grade NS.
5. Shore A hardness of 20-40

B. S-6:

1. ASTM C920, silicone, neutral cure.
2. Type S.
3. Class: Joint movement range of plus 100 percent to minus 50 percent.
4. Grade NS.
5. Shore A hardness of 15-20.
6. Minimum elongation of 1200 percent.

C. S-11:

1. ASTM C920 polyurethane.

2. Type M/S.
3. Class 25.
4. Grade P/NS.
5. Shore A hardness of 35 to 50.

D. S-12:
1. ASTM C920, polyurethane.
2. Type M/S.
3. Class 25, joint movement range of plus or minus 50 percent.
4. Grade P/NS.
5. Shore A hardness of 25 to 50.

2.2 CAULKING COMPOUND:

A. C-1: ASTM C834, acrylic latex.
B. C-2: One component acoustical caulking, non drying, non hardening, synthetic rubber.

2.3 COLOR:

A. Sealants used with exposed masonry shall match color of mortar joints. Provide full range of color samples for selection.
B. Sealants used with unpainted concrete shall match color of adjacent concrete. Provide full range of color samples for selection.
C. Provide full range of color samples for selection for other locations.
D. Caulking shall match neighboring material color - provide sample. Provide full range of color samples for selection.

2.4 JOINT SEALANT BACKING:

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Type C: Closed-cell material with a surface skin.
C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 32° C (minus 26° F). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 FILLER:

A. Mineral fiber board: ASTM C612, Class 1.

B. Thickness same as joint width.

C. Depth to fill void completely behind back-up rod.

2.6 PRIMER:

A. As recommended by manufacturer of caulking or sealant material.

B. Stain free type.

2.7 CLEANERS-NON POUROUS SURFACES:

Chemical cleaners acceptable to manufacturer of sealants and sealant backing material, free of oily residues and other substances capable of staining or harming joint substrates and adjacent non-porous surfaces and formulated to promote adhesion of sealant and substrates.

2.8 NON-STAINING SEALANTS

Sealants to be non-staining to porous substrates provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates.

PART 3 - EXECUTION

3.1 GENERAL:

A. All work performed under this section shall be in accordance with the Specifications, Drawings, and Manufacturer’s instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.2 INSPECTION:

A. Inspect substrate surface for bond breaker contamination and unsound materials at adherent faces of sealant.

B. Coordinate for repair and resolution of unsound substrate materials.

C. Inspect for uniform joint widths and that dimensions are within tolerance established by sealant manufacturer.

3.3 PREPARATIONS:

A. Prepare joints in accordance with manufacturer's instructions and SWRI.

B. Clean surfaces of joint to receive caulking or sealants leaving joint dry to the touch, free from frost, moisture, grease, oil, wax, lacquer

paint, or other foreign matter that would tend to destroy or impair adhesion.

1. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
2. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

C. Do not cut or damage joint edges.

D. Apply masking tape to face of surfaces adjacent to joints before applying primers, caulking, or sealing compounds.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Apply primer to sides of joints wherever required by compound manufacturer's printed instructions.
   1. Apply primer prior to installation of back-up rod or bond breaker tape.
   2. Use brush or other approved means that will reach all parts of joints.

F. Take all necessary steps to prevent three sided adhesion of sealants.

3.4 BACKING INSTALLATION:

A. Install back-up material, to form joints enclosed on three sides as required for specified depth of sealant.

B. Where deep joints occur, install filler to fill space behind the back-up rod and position the rod at proper depth.
C. Cut fillers installed by others to proper depth for installation of back-up rod and sealants.
D. Install back-up rod, without puncturing the material, to a uniform depth, within plus or minus 3 mm (1/8 inch) for sealant depths specified.
E. Where space for back-up rod does not exist, install bond breaker tape strip at bottom (or back) of joint so sealant bonds only to two opposing surfaces.
F. Take all necessary steps to prevent three sided adhesion of sealants.

3.5 SEALANT DEPTHS AND GEOMETRY:

A. At widths up to 6 mm (1/4 inch), sealant depth equal to width as per manufacturer specifications.
B. At widths over 6 mm (1/4 inch), sealant depth 1/2 of width up to 13 mm (1/2 inch) maximum depth at center of joint with sealant thickness at center of joint approximately 1/2 of depth at adhesion surface as per manufacturer specifications.

3.6 INSTALLATION:

A. General:
1. Apply sealants and caulking only when ambient temperature is between 5° C and 38° C (40° and 100° F).
2. Do not use polysulfide base sealants where sealant may be exposed to fumes from bituminous materials, or where water vapor in continuous contact with cementitious materials may be present.
3. Do not use sealant type listed by manufacture as not suitable for use in locations specified.
4. Apply caulking and sealing compound in accordance with manufacturer's printed instructions.
5. Avoid dropping or smearing compound on adjacent surfaces.
6. Fill joints solidly with compound and finish compound smooth.
7. Tool joints to concave surface unless shown or specified otherwise.
8. Finish paving or floor joints flush unless joint is otherwise detailed.
9. Apply compounds with nozzle size to fit joint width.
10. Test sealants for compatibility with each other and substrate. Use only compatible sealant.

B. For application of sealants, follow requirements of ASTM C1193 unless specified otherwise.

C. Where gypsum board partitions are of sound rated, fire rated, or smoke barrier construction, follow requirements of ASTM C919 only to seal all cut-outs and intersections with the adjoining construction unless specified otherwise.

1. Control Joints: Before control joints are installed, apply sealant in back of control joint to reduce flanking path for sound through control joint.

3.7 FIELD QUALITY CONTROL:

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as recommended by sealant manufacturer:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform 10 tests for first 300 m (1000 feet) of joint length for each type of elastomeric sealant and joint substrate.

b. Perform one test for each 300 m (1000 feet) of joint length thereafter.

B. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

C. Inspect tested joints and report on following:

1. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

2. Compare these results to determine if adhesion passes sealant manufacturer’s field-adhesion hand-pull test criteria.

3. Whether sealants filled joint cavities and are free from voids.

4. Whether sealant dimensions and configurations comply with specified requirements.

D. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

E. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that

original sealant surfaces are clean and new sealant contacts original sealant.

F. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.8 CLEANING:

A. Fresh compound accidentally smeared on adjoining surfaces: Scrape off immediately and rub clean with a solvent as recommended by the caulking or sealant manufacturer.

B. After filling and finishing joints, remove masking tape.

C. Leave adjacent surfaces in a clean and unstained condition.

3.9 LOCATIONS:

A. Exterior Building Joints, Horizontal and Vertical:

1. Metal to Masonry or Stone: Type S-1
2. Masonry to Masonry or Stone: Type S-1
3. Stone to Stone: Type S-1
4. Cast Stone to Cast Stone: Type S-1
5. Masonry Expansion and Control Joints: Type S-6

B. Metal Reglets and Flashings:

1. Flashings to Wall: Type S-6
2. Metal to Metal: Type S-6

C. Horizontal Traffic Joints:

1. Concrete Paving, Unit Pavers: Type S-11 or S-12

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SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. This section specifies the requirements for furnishing all equipment, materials, labor, tools, and techniques for earthwork including, but not limited to, the following:

1. Site preparation.
2. Excavation.
3. Filling and backfilling.
4. Grading.
5. Soil Disposal.
6. Clean Up.

1.2 DEFINITIONS:

A. Unsuitable Materials:

1. Fills: Topsoil; frozen materials; construction materials and materials subject to decomposition; clods of clay and stones larger than 75 mm (3 inches); organic material, including silts, which are unstable; and inorganic materials, including silts, too wet to be stable and any material with a liquid limit and plasticity index exceeding 40 and 15 respectively. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction, as defined by ASTM D 698.
2. Existing Subgrade (Except Footing Subgrade): Same materials as 1.2.A.1, that are not capable of direct support of slabs, pavement, and similar items with possible exception of improvement by compaction, proofrolling, or similar methods.
3. Existing Subgrade (Footings Only): Same as paragraph 1, but no fill or backfill. If materials differ from reference borings and design requirements, excavate to acceptable strata subject to COTR's approval.

B. Building Earthwork: Earthwork operations required in area enclosed by a line located 1500 mm (5 feet) outside of principal building perimeter. It also includes earthwork required for auxiliary structures and buildings (Columbarium Wall).

C. Trench Earthwork: Trenchwork required for utility lines.

D. Site Earthwork: Earthwork operations required in area outside of a line located 1500 mm (5 feet) outside of principal building perimeter and within new construction area with exceptions noted above.
E. Degree of compaction: Degree of compaction is expressed as a percentage of maximum density obtained by laboratory test procedure. This percentage of maximum density is obtained through use of data provided from results of field test procedures presented in ASTM D1556, ASTM D2167, and ASTM D2922.
F. Fill: Satisfactory soil materials used to raise existing grades. In the Construction Documents, the term “fill” means fill or backfill as appropriate.
G. Backfill: Soil materials or controlled low strength material used to fill an excavation.
H. Unauthorized excavation: Removal of materials beyond indicated sub-grade elevations or indicated lines and dimensions without written authorization by the COTR. No payment will be made for unauthorized excavation or remedial work required to correct unauthorized excavation.
I. Authorized additional excavation: Removal of additional material authorized by the COTR based on the determination by the Government’s soils testing agency that unsuitable bearing materials are encountered at required sub-grade elevations. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.
J. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials.
K. Structure: Buildings, foundations, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
L. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
M. Drainage course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
N. Bedding course: Layer placed over the excavated sub-grade in a trench before laying pipe. Bedding course shall extend up to the springline of the pipe.
O. Sub-base Course: Layer placed between the sub-grade and base course for asphalt paving or layer placed between the sub-grade and a concrete pavement or walk.
P. Utilities include on-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

Q. Debris: Debris includes all materials located within the designated work area not covered in the other definitions and shall include but not be limited to items like vehicles, equipment, appliances, building materials or remains thereof, tires, any solid or liquid chemicals or products stored or found in containers or spilled on the ground.

R. Contaminated soils: Soil that contains contaminates as defined and determined by the COTR or the Government's testing agency.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

E. Erosion Control: Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS, and Section 32 90 00, PLANTING.

1.4 CLASSIFICATION OF EXCAVATION:

A. Classified Excavation: Removal and disposal of all material except that material not defined as Rock.

B. Rock Excavation:

1. Trenches and Pits: Removal and disposal of solid, homogenous, interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be excavated with a late-model, 40,000 lb, track-mounted hydraulic excavator; equipped with a 18 inch wide, short-tip-radius rock bucket with hard rock teeth; rated at not less than 103 kW (138 hp) flywheel power with bucket-curling force of not less than 125 kN (28,090 lbf) and stick-crowd force of not less than 84.5 kN (19,000 lbf); measured according to SAE J-1179. Trenches in excess of 3000 mm (10 feet) wide and pits in excess of 9000 mm (30 feet) in either length or width are classified as open excavation.
2. Open Excavation: Removal and disposal of solid, homogenous, interlocking crystalline material firmly cemented, laminated, or foliated masses or conglomerate deposits that cannot be dislodged and excavated with a late-model, track-mounted loader; rated at not less than 157 kW (210 hp) flywheel power and developing a minimum of 216 kN (48,510 lbf) breakout force; measured according to SAE J-732.
3. Other types of materials classified as rock are unstratified masses, conglomerated deposits and boulders of rock material exceeding 0.76

m3 (1 cubic yard) for open excavation, or 0.57 m3 (3/4 cubic yard) for footing and trench excavation that cannot be removed by rock excavating equipment equivalent to the above in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted.

4. Blasting: Blasting is not allowed.
5. Definitions of rock and guidelines for equipment are presented for general information purposes only. The Contractor is expected to use the information presented in the Geotechnical Engineering Report to evaluate the extent and competency of the rock and to determine both quantity estimations and removal equipment and efforts.

1.5 MEASUREMENT AND PAYMENT FOR ROCK EXCAVATION:

A. Measurement: Cross section and measure uncovered and separated materials, and compute quantities by Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS. Do not measure quantities beyond the following limits:
   1. 600 mm (24 inches) from outside face of concrete work for which forms are required, except for footings.
   2. 300 mm (12 inches) from outside of perimeter of formed footings.
   3. 150 mm (6 inches) below bottom of pipe and not more than pipe diameter plus 600 mm (24 inches) in width for pipe trenches.
   4. From outside dimensions of concrete work for which no forms are required (trenches, conduits, and similar items not requiring forms).

B. Payment: No separate payment shall be made for estimated rock excavation quantities shown on plan. Contract price will be adjusted for overruns or underruns in accordance with the established contract unit price. The unit price shall be for excavation and disposal of each in-place cubic yard of rock.

1.6 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Rock Excavation Report:
   1. Certification of rock quantities excavated.
   2. Excavation method.
   3. Labor.
   4. Equipment.
   5. Land Surveyor's or Civil Engineer's name and official registration stamp.
   6. Plot plan showing elevation.

C. Furnish to COTR:

1. Contactor shall furnish resumes with all personnel involved in the project including Project Manager and Superintendent. Project Manager and Superintendent should have at least 3 years of experience on projects of similar size.
2. Soil samples.
   a. Classification in accordance with ASTM D2487 for each on-site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
   b. Laboratory compaction curve in accordance with ASTM D 698 for each on site or borrow soil material proposed for fill, backfill, engineered fill, or structural fill.
   c. Test reports for compliance with ASTM D 2940 requirements for subbase material.
   d. Pre-excavation photographs and videotape in the vicinity of the existing structures to document existing site features, including surfaces finishes, cracks, or other structural blemishes that might be misconstrued as damage caused by earthwork operations.
   e. The Contractor shall submit a scale plan daily that defines the location, limits, and depths of the area excavated.

1.7 APPLICABLE PUBLICATIONS:

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

T99-01(2004).....Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and a 305 mm (12 inch) Drop

T180-01(2004).....Moisture-Density Relations of Soils using a 4.54 kg (10 lb) Rammer and a 457 mm (18 inch) Drop

C. American Society for Testing and Materials (ASTM):

D448-03a.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D698-00ae1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft. lbf/ft^3 (600 kN m/m^3))

D1556-00.....Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D1557-02e1.....Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN m/m^3))

D2167-94 (2001).....Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
D2487-06.....Standard Classification of Soil for Engineering Purposes (Unified Soil Classification System)
D2922-05.....Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D2940-03.....Standard Specifications for Graded Aggregate Material for Bases or Subbases for Highways or Airports

D. Society of Automotive Engineers (SAE):
J732-92.....Specification Definitions - Loaders
J1179-02.....Hydraulic Excavator and Backhoe Digging Forces

PART 2 - PRODUCTS

2.1 MATERIALS:

A. General: Provide borrow soil material when sufficient satisfactory soil materials are not available from excavations.

B. Fills: Material in compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups; free of rock or gravel larger than 75 mm (3 inches) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Material approved from on site or off site sources having a minimum dry density of 1760 kg/m3 (110 pcf), a maximum Plasticity Index of 15, and a maximum Liquid Limit of 40 or as specified in the geotechnical report. Imported granular fill consisting of hard, angular (crushed rock).

C. Engineered Fill: Naturally or artificially graded mixture of compliance with ASTM D2487 Soil Classification Groups GW, GP, GM, SW, SP, SM, SC, and ML, or any combination of these groups, or as approved by the Engineer or material with, 100% passing the 2 inch sieve, at least 90 percent passing a 37.5-mm (1 1/2-inch) sieve and not more than 12 percent passing a 75-µm (No. 200) sieve, per ASTM D2940; or as specified in the geotechnical report. The upper 6 inches of engineered fill areas (for final grading) may utilize crushed rock with 100% passing the 1 inch sieve, 90 to 100% passing the 3/4” sieve and less than 10% passing the No. 200 sieve.

D. Bedding & Trench Backfill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 25 mm (1 inch) sieve and not more than 8 percent passing a 75-µm (No. 200) sieve.

E. Drainage Fill and River Wash Stone Bed: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; coarse-aggregate grading with 100 percent passing a 1/2-inch sieve, 85 to 100% passing 3/8″ sieve, 10 to 30% passing No. 4 sieve. A rounded natural, multi-colored aggregate is preferred.

PART 3 - EXECUTION

3.1 SITE PREPARATION:

A. Clearing: Clear within limits of earthwork operations as shown. Work includes removal of trees, shrubs, fences, foundations, incidental structures, paving, debris, trash, and other obstructions. Remove materials from Cemetery Property.

B. Grubbing: Remove stumps and roots 75 mm (3 inch) and larger diameter. Undisturbed sound stumps, roots up to 75 mm (3 inch) diameter, and nonperishable solid objects a minimum of 900 mm (3 feet) below subgrade or finished embankment may be left. Cemetery Projects: do not leave material within burial profile up to 2400 mm (8 feet) below finished grade.

C. Trees and Shrubs: Trees and shrubs, not shown for removal, may be removed from areas within 4500 mm (15 feet) of new construction and 2250 mm (7.5 feet) of utility lines when removal is approved in advance by COTR. Remove materials from Cemetery Property. Trees and shrubs, shown to be transplanted, shall be dug with a ball of earth and burlapped in accordance with latest issue of, "American Standard for Nursery Stock" of the American Association of Nurserymen, Inc. Transplant trees and shrubs to a permanent or temporary position within two hours after digging. Maintain trees and shrubs held in temporary locations by watering as necessary and feeding semiannually with liquid fertilizer with a minimum analysis of 5 percent nitrogen, 10 percent phosphorus, and 5 percent potash. Maintain plants moved to permanent positions as specified for plants in temporary locations until conclusion of contract. Box, and otherwise protect from damage, existing trees and shrubs which are not shown to be removed in construction area. Immediately repair damage to existing trees and shrubs by trimming, cleaning and painting damaged areas, including roots, in accordance with standard industry horticultural practice for the geographic area and plant species. Do not store building materials closer to trees and shrubs, that are to remain, than farthest extension of their limbs.

D. Stripping Topsoil: Strip topsoil from within limits of earthwork operations as specified. Topsoil shall be a fertile, friable, natural topsoil of loamy character and characteristic of locality. Topsoil shall

be capable of growing healthy horticultural crops of grasses. Stockpile topsoil and protect as directed by COTR. Eliminate foreign materials, such as weeds, roots, stones, subsoil, frozen clods, and similar foreign materials larger than 0.014 m3 (1/2 cubic foot) in volume, from soil as it is stockpiled. Retain topsoil on station. Remove foreign materials larger than 50 mm (2 inches) in any dimension from topsoil used in final grading. Topsoil work, such as stripping, stockpiling, and similar topsoil work shall not, under any circumstances, be carried out when soil is wet so that the composition of the soil will be destroyed. Cemetery Projects: Test the soil for chemicals, pesticides and fertilizers if topsoil is to be removed from lands formerly utilized as farmland, to verify suitability for use as topsoil in the cemetery where new lawn areas are to be established.

E. Concrete Slabs and Paving: Score deeply or saw cut to insure a neat, straight cut, sections of existing concrete slabs and paving to be removed where excavation or trenching occurs. Extend pavement section to be removed a minimum of 300 mm (12 inches) on each side of widest part of trench excavation and insure final score lines are approximately parallel unless otherwise indicated. Remove material from Cemetery Property.

F. Lines and Grades: Registered Professional Land Surveyor or Registered Civil Engineer, specified in Section 01 00 00, GENERAL REQUIREMENTS, shall establish lines and grades.

1. Grades shall conform to elevations indicated on plans within the tolerances herein specified. Generally grades shall be established to provide a smooth surface, free from irregular surface changes. Grading shall comply with compaction requirements and grade cross sections, lines, and elevations indicated. Where spot grades are indicated the grade shall be established based on interpolation of the elevations between the spot grades while maintaining appropriate transition at structures and paving and uninterrupted drainage flow into inlets.
2. Locations of existing and proposed elevations indicated on plans ,except spot elevations, are approximate from a site survey that measured spot elevations and subsequently generated existing contours and spot elevations. Proposed spot elevations and contour lines have been developed utilizing the existing conditions survey and developed contour lines and may be approximate. Contractor is responsible to notify COTR of any differences between existing elevations shown on plans and those encountered on site by Surveyor/Engineer described

above. Notify COTR of any differences between existing or constructed grades, as compared to those shown on the plans.

3. Subsequent to establishment of lines and grades, Contractor will be responsible for any additional cut and/or fill required to ensure that site is graded to conform to elevations indicated on plans.
4. Finish grading is specified in Section 32 90 00, PLANTING.

G. Disposal: All materials removed from the property shall be disposed of at a legally approved site, for the specific materials, and all removals shall be in accordance with all applicable Federal, State and local regulations. No burning of materials is permitted onsite.

3.2 EXCAVATION:

A. Shoring, Sheeting and Bracing: Shore, brace, or slope, its angle of repose or to an angle considered acceptable by the COTR, banks of excavations to protect workmen, banks, adjacent paving, structures, and utilities.

1. Design of the temporary support of excavation system is the responsibility of the Contractor.
2. Construction of the support of excavation system shall not interfere with the permanent structure and may begin only after a review by the COTR.
3. Extend shoring and bracing to a minimum of 1500 mm (5 feet) below the bottom of excavation. Shore excavations that are carried below elevations of adjacent existing foundations.
4. If bearing material of any foundation is disturbed by excavating, improper shoring or removal of existing or temporary shoring, placing of backfill, and similar operations, the Contractor shall provide a concrete fill support in compliance with specifications Section 31 23 23.33, FLOWABLE FILL, under disturbed foundations, as directed by COTR, at no additional cost to the Government. Do not remove shoring until permanent work in excavation has been inspected and approved by COTR.

B. Excavation Drainage: Operate pumping equipment, and/or provide other materials, means and equipment as required to keep excavation free of water and subgrade dry, firm, and undisturbed until approval of permanent work has been received from COTR. Approval by the COTR is also required before placement of the permanent work on all subgrades.

C. Subgrade Protection: Protect subgrades from softening, undermining, washout, or damage by rain or water accumulation. Reroute surface water runoff from excavated areas and not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage

ditches. When subgrade for foundations has been disturbed by water, remove disturbed material to firm undisturbed material after water is brought under control. Replace disturbed subgrade in trenches with concrete or material approved by the COTR.

D. Blasting: No blasting of materials shall be.
E. Proofrolling:
   1. After rough grade has been established in cut areas and prior to placement of fill in fill areas under building and pavements, proofroll exposed subgrade with a fully loaded dump truck to check for pockets of soft material.
   2. Proofrolling shall consist of at least two complete passes with one pass being in a direction perpendicular to preceding one. Remove any areas that deflect, rut, or pump excessively during proofrolling, or that fail to consolidate after successive passes to suitable soils and replaced with compacted fill. Maintain subgrade until succeeding operation has been accomplished.
F. Building Earthwork:
   1. Excavation shall be accomplished as required by drawings and specifications.
   2. Excavate foundation excavations to solid undisturbed subgrade.
   3. Remove loose or soft materials to a solid bottom.
   4. Fill excess cut under footings or foundations with 25 MPa (3000 psi) concrete poured separately from the footings.
   5. Do not tamp earth for backfilling in footing bottoms, except as specified.
   6. Slope grades to direct water away from excavations and to prevent ponding.
G. Trench Earthwork:
   1. Utility trenches (except sanitary and storm sewer):
      a. Excavate to a width as necessary for sheeting and bracing and proper performance of the work.
      b. Grade bottom of trenches with bell holes scooped out to provide a uniform bearing.
      c. Support piping on undisturbed earth unless a mechanical support is shown.
      d. Length of open trench in advance of piping laying shall not be greater than is authorized by COTR.
   2. Sanitary and storm sewer trenches:
      a. Trench width below a point 150 mm (6 inches) above top of pipe shall be 600 mm (24 inches) maximum for pipe up to and including

300 mm (12 inches) diameter, and four-thirds diameter of pipe plus 200 mm (8 inches) for pipe larger than 300 mm (12 inches). Width of trench above that level shall be as necessary for sheeting and bracing and proper performance of the work.

b. Bed bottom quadrant of pipe on undisturbed soil or granular fill.
   1) Undisturbed: Bell holes shall be no larger than necessary for jointing. Backfill up to a point 300 mm (12 inches) above top of pipe shall be clean earth placed and tamped by hand.
   2) Granular Fill: Depth of fill shall be a minimum of 75 mm (3 inches) plus one sixth of pipe diameter below pipe to 300 mm (12 inches) above top of pipe. Place and tamp fill material by hand.

c. Place and compact as specified remainder of backfill using acceptable excavated materials. Do not use unsuitable materials.

d. Use granular fill for bedding where rock or rocky materials are excavated.

H. Site Earthwork: Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation. Excavation shall be accomplished as required by drawings and specifications. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm (1 inch). Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, complying with OSHA requirements, and for inspections. Remove subgrade materials that are determined by COTR as unsuitable, and replace with acceptable material. Testing of the soil shall be performed by the Contractor obtained Testing Laboratory. When unsuitable material is encountered and removed, contract price and time will be adjusted in accordance with Articles, DIFFERING SITE CONDITIONS, CHANGES and CHANGES-SUPPLEMENT of the GENERAL CONDITIONS as applicable. Adjustments to be based on volume in cut section only.

1. Site Grading:
   a. Provide a smooth transition between adjacent existing grades and new grades.
   b. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

c. Slope grades to direct water away from buildings and to prevent ponds from forming where not designed. Finish subgrades to required elevations within the following tolerances:
   1) Lawn or Unpaved Areas: Plus or minus 25 mm (1 inch).
   2) Walks: Plus or minus 25 mm (1 inch).
   3) Pavements: Plus or minus 13 mm (1 inch).

d. Grading Inside Courtyard Lines: Finish subgrade to a tolerance of (1/2 inch) when tested with a 10 foot straightedge.

3.3 FILLING AND BACKFILLING:

A. General: Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation. For fill and backfill, use excavated materials and borrow meeting the criteria specified herein, as applicable. Borrow will be supplied at no additional cost to the Government. Do not use unsuitable excavated materials. Do not backfill until foundation walls have been completed above grade and adequately braced, waterproofing or dampproofing applied, foundation drainage, and pipes coming in contact with backfill have been installed and work inspected and approved by COTR.

B. Placing: Place materials in horizontal layers not exceeding 200 mm (8 inches) in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm (4 inches) in loose depth for material compacted by hand-operated tampers and then compacted. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure. Place no material on surfaces that are muddy, frozen, or contain frost.

C. Compaction: Compact with approved tamping rollers, sheepsfoot rollers, pneumatic tired rollers, steel wheeled rollers, vibrator compactors, or other approved equipment (hand or mechanized) well suited to soil being compacted. Do not operate mechanized vibratory compaction equipment within 3000 mm (10 feet) of new or existing building walls without prior approval of COTR. Moisten or aerate material as necessary to provide moisture content that will readily facilitate obtaining specified compaction with equipment used. Compact soil to not less than the following percentages of maximum dry density, according to ASTM D698 or ASTM D1557 as specified below:

1. Fills, Embankments, and Backfill

   a. Under proposed structures, building slabs, steps, and paved areas, scarify and recompact top 300 mm (12 inches) of existing subgrade

and each layer of backfill or fill material in accordance with ASTM D698 95 percent.

b. Curbs, curbs and gutters, ASTM D698 95 percent.

c. Under Sidewalks, scarify and recompact top 150 mm (6 inches) below subgrade and compact each layer of backfill or fill material in accordance with ASTM D698 95 percent.

d. Landscaped areas, top 400 mm (16 inches ASTM D698 85 percent.

e. Landscaped areas, below 400 mm (16 inches) of finished grade, ASTM D698 95 percent.

2. Natural Ground (Cut or Existing)

a. Under building slabs, steps and paved areas, top 150 mm (6 inches), ASTM D698 95 percent.

b. Curbs, curbs and gutters, top 150 mm (6 inches), ASTM D698 95 percent.

c. Under sidewalks, top 150 mm (6 inches), ASTM D698 95 percent.

3.4 GRADING:

A. General: Uniformly grade the areas within the limits of this section, including adjacent transition areas. Smooth the finished surface within specified tolerance. Provide uniform levels or slopes between points where elevations are indicated, or between such points and existing finished grades. Provide a smooth transition between abrupt changes in slope.

B. Cut rough or sloping rock to level beds for foundations. In pipe spaces or other unfinished areas, fill low spots and level off with coarse sand or fine gravel.

C. Slope backfill outside columbaria away from columbaria for a minimum distance of 1800 mm (6 feet).

D. Finish grade earth floors in pipe basements as shown to a level, uniform slope and leave clean.

E. Place crushed stone or gravel fill under concrete slabs on grade, tamped, and leveled. Thickness of fill shall be 150 mm (6 inches) unless otherwise shown.

F. Finish subgrade in a condition acceptable to COTR at least one day in advance of paving operations. Maintain finished subgrade in a smooth and compacted condition until succeeding operation has been accomplished. Scarify, compact, and grade subgrade prior to further construction when approved compacted subgrade is disturbed by Contractor's subsequent operations or adverse weather.

G. Grading for Paved Areas: Provide final grades for both subgrade and base course to +/- 6 mm (0.25 inches) of indicated grades.

3.5 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL:

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Cemetery property.

B. Place excess excavated materials suitable for fill and/or backfill on site where directed.

C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

D. Segregate all excavated contaminated soil designated by the COTR from all other excavated soils, and stockpile on site on two 0.15 mm (6 mil) polyethylene sheets with a polyethylene cover. A designated area shall be selected for this purpose. Dispose of excavated contaminated material in accordance with State and Local requirements.

3.6 CLEAN UP:

Upon completion of earthwork operations, clean areas within contract limits, remove tools, and equipment. Provide site clear, clean, free of debris, and suitable for subsequent construction operations. Remove all debris, rubbish, and excess material from Cemetery Property.

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SECTION 32 05 23
CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section shall cover site work concrete constructed upon the prepared subgrade and in conformance with the lines, grades, thickness, and cross sections shown. Construction shall include the following:

B. Curb, gutter, and combination curb and gutter.

C. Pedestrian Pavement: Walks and grade slabs.

D. Vehicular Pavement: driveways.

1.2 RELATED WORK

A. Laboratory and Field Testing Requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Section 31 20 00, EARTH MOVING.

C. Concrete Materials, Quality, Mixing, Design and Other Requirements: Section 03 30 00, CAST-IN-PLACE-CONCRETE.

1.3 DESIGN REQUIREMENTS

Design all elements with the latest published version of applicable codes.

1.4 WEATHER LIMITATIONS

Placement of concrete shall be as specified under Article 3.8, COLD WEATHER and Article 3.7, HOT WEATHER of Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.5 SELECT SUBBASE MATERIAL JOB-MIX

The Contractor shall retain and reimburse a testing laboratory to design a select subbase material mixture and submit a job-mix formula to the COTR, in writing, for approval. The formula shall include the source of materials, gradation, plasticity index, liquid limit, and laboratory compaction curves indicating maximum density at optimum moisture.

1.6 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Manufacturers' Certificates and Data certifying that the following materials conform to the requirements specified.

1. Expansion joint filler
2. Hot poured sealing compound
3. Reinforcement
4. Curing materials

C. Data and Test Reports: Select subbase material.
   1. Job-mix formula.
   2. Source, gradation, liquid limit, plasticity index, percentage of wear, and other tests as specified and in referenced publications.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. Refer to the latest edition of all referenced Standards and codes.

B. American Association of State Highway and Transportation Officials (AASHTO):

M31.....Deformed and Plain Billet Steel Bars for Concrete Reinforcement (ASTM A615/A615M-96A)

M55M/55M.....Welded Steel Wire Fabric for Concrete Reinforcement (ASTM A185)

M147.....Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses (R 1996)

M148.....Liquid Membrane-Forming Compounds for Curing Concrete (ASTM C309A)

M171.....Sheet Materials for Curing Concrete (ASTM C171

M182.....Burlap Cloth Made from Jute or Kenaf

M213.....Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Type) (ASTM D1751)

T99.....Moisture-Density Relations of Soils Using a 2.5 kg. (5.5 lb) Rammer and a 305 mm (12 in.) Drop

T180.....Moisture-Density Relations of Soils Using a 4.54 kg (10 lb.) Rammer and a 457 mm (18 in.) Drop

C. American Society for Testing and Materials (ASTM):

C94/C94M.....Ready-Mixed Concrete

C143/C143M.....Slump of Hydraulic Cement Concrete

PART 2 - PRODUCTS

2.1 GENERAL

Concrete shall be Type C, air-entrained as specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, with the following exceptions:

TYPE	MAXIMUM SLUMP*

Curb & Gutter	75 mm (3")
Pedestrian Pavement	75 mm (3")
Vehicular Pavement	50 mm (2") (Machine Finished) 100 mm (4") (Hand Finished)
Equipment Pad	75 to 100 mm (3" to 4")
* For concrete to be vibrated: Slump as determined by ASTM C143. Tolerances as established by ASTM C94.	

2.2 REINFORCEMENT

A. The type, amount, and locations of steel reinforcement shall be as shown on the drawings and in the specifications.

B. Welded wire-fabric shall conform to AASHTO M55.

C. Dowels shall be plain steel bars conforming to AASHTO M31 or M42. Tie bars shall be deformed steel bars conforming to AASHTO M31 or M42.

2.3 SELECT SUBBASE (WHERE REQUIRED)

A. Subbase material shall consist of select granular material composed of sand, sand-gravel, crushed stone, crushed or granulated slag, with or without soil binder, or combinations of these materials conforming to AASHTO M147, Grading E or F.

B. Materials meeting other gradations than that noted will be acceptable whenever the gradations are within a tolerance of three to five percent, plus or minus, of the single gradation established by the job-mix formula.

C. Subbase material shall produce a compacted, dense-graded course, meeting the density requirement specified herein.

2.4 FORMS

A. Use metal or wood forms that are straight and suitable in cross-section, depth, and strength to resist springing during depositing and consolidating the concrete, for the work involved.

B. Do not use forms if they vary from a straight line more than 3 mm (1/8 inch) in any 3000 mm (ten foot) long section, in either a horizontal or vertical direction.

C. Wood forms should be at least 50 mm (2 inches) thick (nominal). Wood forms shall also be free from warp, twist, loose knots, splits, or other defects. Use approved flexible or curved forms for forming radii.

2.5 CONCRETE CURING MATERIALS

A. Concrete curing materials shall conform to one of the following:

1. Burlap conforming to AASHTO M182 having a weight of 233 grams (seven ounces) or more per square meter (yard) when dry.
2. Impervious Sheeting conforming to AASHTO M171.

3. Liquid Membrane Curing Compound conforming to AASHTO M148 (ASTM C309), Type 1 and shall be free of paraffin or petroleum.

2.6 EXPANSION JOINT FILLERS

Material shall conform to AASHTO M213.

PART 3 - EXECUTION

3.1 SUBGRADE PENETRATION

A. Prepare, construct, and finish the subgrade as specified in Section 31 20 00, EARTH MOVING.

B. Maintain the subgrade in a smooth, compacted condition, in conformance with the required section and established grade until the succeeding operation has been accomplished.

3.2 SELECT SUBBASE (WHERE REQUIRED)

A. Mixing: Proportion the select subbase by weight or by volume in quantities so that the final approved job-mixed formula gradation, liquid limit, and plasticity index requirements will be met after subbase course has been placed and compacted. Add water in approved quantities, measured by weight or volume, in such a manner to produce a uniform blend.

B. Placing:

1. Place the mixed material on the prepared subgrade in a uniform layer to the required contour and grades, and to a loose depth not to exceed 200 mm (8 inches), and that when compacted, will produce a layer of the designated thickness.
2. When the designated compacted thickness exceeds 150 mm (6 inches), place the material in layers of equal thickness. Remove unsatisfactory areas and replace with satisfactory mixture, or mix the material in the area.
3. In no case will the addition of thin layers of material be added to the top layer in order to meet grade.
4. If the elevation of the top layer is 13 mm (1/2 inch) or more below the grade, excavate the top layer and replace with new material to a depth of at least 75 mm (3 inches) in compacted thickness.

C. Compaction:

1. Perform compaction with approved equipment (hand or mechanical) well suited to the material being compacted.
2. Moisten or aerate the material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

3. Compact each layer to at least 95 percent or 100 percent of maximum density as determined by AASHTO T180 or AASHTO T99 respectively.

D. Smoothness Test and Thickness Control:
Test the completed subbase for grade and cross section with a straight edge.
1. The surface of each layer shall not show any deviations in excess of 10 mm (3/8 inch).
2. The completed thickness shall be within 13 mm (1/2 inch) of the thickness as shown.

E. Protection:
1. Maintain the finished subbase in a smooth and compacted condition until the concrete has been placed.
2. When Contractor's subsequent operations or adverse weather disturbs the approved compacted subbase, excavate, and reconstruct it with new material meeting the requirements herein specified, at no additional cost to the VA.

3.3 SETTING FORMS

A. Base Support:
1. Compact the base material under the forms true to grade so that, when set, they will be uniformly supported for their entire length at the grade as shown.
2. Correct imperfections or variations in the base material grade by cutting or filling and compacting.

B. Form Setting:
1. Set forms sufficiently in advance of the placing of the concrete to permit the performance and approval of all operations required with and adjacent to the form lines.
2. Set forms to true line and grade and use stakes, clamps, spreaders, and braces to hold them rigidly in place so that the forms and joints are free from play or movement in any direction.
3. Forms shall conform to line and grade with an allowable tolerance of 3 mm (1/8 inch) when checked with a straightedge and shall not deviate from true line by more than 6 mm (1/4 inch) at any point.
4. Do not remove forms until removal will not result in damaged concrete or at such time to facilitate finishing.
5. Clean and oil forms each time they are used.

C. The Contractor’s Registered Professional Land Surveyor, specified in Section 00 72 00, GENERAL CONDITIONS, shall establish and control the alignment and the grade elevations of the forms or concrete slipforming machine operations.

1. Make necessary corrections to forms immediately before placing concrete.
2. When any form has been disturbed or any subgrade or subbase has become unstable, reset and recheck the form before placing concrete.

3.4 EQUIPMENT

A. The COTR shall approve equipment and tools necessary for handling materials and performing all parts of the work prior to commencement of work.

B. Maintain equipment and tools in satisfactory working condition at all times.

3.5 PLACING REINFORCEMENT

A. Reinforcement shall be free from dirt, oil, rust, scale or other substances that prevent the bonding of the concrete to the reinforcement.

B. Before the concrete is placed, the COTR shall approve the reinforcement, which shall be accurately and securely fastened in place with suitable supports and ties. The type, amount, and position of the reinforcement shall be as shown.

3.6 PLACING CONCRETE - GENERAL

A. Obtain approval of the COTR before placing concrete.

B. Remove debris and other foreign material from between the forms before placing concrete. Obtain approval of the COTR before placing concrete.

C. Before the concrete is placed, uniformly moisten the subgrade, base, or subbase appropriately, avoiding puddles of water.

D. Convey concrete from mixer to final place of deposit by a method which will prevent segregation or loss of ingredients. Deposit concrete so that it requires as little handling as possible.

E. While being placed, spade or vibrate and compact the concrete with suitable tools to prevent the formation of voids or honeycomb pockets. Vibrate concrete well against forms and along joints. Over-vibration or manipulation causing segregation will not be permitted. Place concrete continuously between joints without bulkheads.

F. Install a construction joint whenever the placing of concrete is suspended for more than 30 minutes and at the end of each day's work.

G. Workmen or construction equipment coated with foreign material shall not be permitted to walk or operate in the concrete during placement and finishing operations.

3.7 PLACING CONCRETE FOR CURB AND GUTTER, PEDESTRIAN PAVEMENT, AND EQUIPMENT PADS

A. Place concrete in the forms in one layer of such thickness that, when compacted and finished, it will conform to the cross section as shown.

B. Deposit concrete as near to joints as possible without disturbing them but do not dump onto a joint assembly.
C. After the concrete has been placed in the forms, use a strike-off guided by the side forms to bring the surface to the proper section to be compacted.
D. Consolidate the concrete thoroughly by tamping and spading, or with approved mechanical finishing equipment.
E. Finish the surface to grade with a wood or metal float.
F. All Concrete pads and pavements shall be constructed with sufficient slope to drain properly.

3.8 PLACING CONCRETE FOR VEHICULAR PAVEMENT

A. Deposit concrete into the forms as close as possible to its final position.
B. Place concrete rapidly and continuously between construction joints.
C. Strike off concrete and thoroughly consolidate by a finishing machine, vibrating screed, or by hand-finishing.
D. Finish the surface to the elevation and crown as shown.
E. Deposit concrete as near the joints as possible without disturbing them but do not dump onto a joint assembly. Do not place adjacent lanes without approval by the COTR.

3.9 CONCRETE FINISHING - GENERAL

A. The sequence of operations, unless otherwise indicated, shall be as follows:
   1. Consolidating, floating, straight-edging, troweling, texturing, and edging of joints.
   2. Maintain finishing equipment and tools in a clean and approved condition.

3.10 CONCRETE FINISHING CURB AND GUTTER

A. Round the edges of the gutter and top of the curb with an edging tool to a radius of 6mm (1/4 inch) or as otherwise detailed.
B. Float the surfaces and finish with a smooth wood or metal float until true to grade and section and uniform in textures.
C. Finish the surfaces, while still wet, with a bristle type brush with longitudinal strokes.
D. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the surface, while still wet, in the same manner as the gutter and curb top.
E. Except at grade changes or curves, finished surfaces shall not vary more than 3 mm (1/8 inch) for gutter and 6 mm (1/4 inch) for top and face of curb, when tested with a 3000 mm (10 foot) straightedge.

F. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.
G. Correct any depressions which will not drain.
H. Visible surfaces and edges of finished curb, gutter, and combination curb and gutter shall be free of blemishes, form marks, and tool marks, and shall be uniform in color, shape, and appearance.

3.11 CONCRETE FINISHING PEDESTRIAN PAVEMENT

A. Walks, Grade Slabs:
   1. Finish the surfaces to grade and cross section with a metal float, trowled smooth and finished with a broom moistened with clear water.
   2. Brooming shall be transverse to the line of traffic.
   3. Finish all slab edges, including those at formed joints, carefully with an edger having a radius as shown on the Drawings.
   4. Unless otherwise indicated, edge the transverse joints before brooming. The brooming shall eliminate the flat surface left by the surface face of the edger. Execute the brooming so that the corrugation, thus produced, will be uniform in appearance and not more than 2 mm (1/16 inch) in depth.
   5. The completed surface shall be uniform in color and free of surface blemishes, form marks, and tool marks. The finished surface of the pavement shall not vary more than 5 mm (3/16 inch) when tested with a 3000 mm (10 foot) straightedge.
   6. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).
   7. Remove and reconstruct irregularities exceeding the above for the full length between regularly scheduled joints.

3.12 CONCRETE FINISHING FOR VEHICULAR PAVEMENT

A. Accomplish longitudinal floating with a longitudinal float not less than 3000 mm (10 feet) long and 150 mm (6 inches) wide, properly stiffened to prevent flexing and warping. Operate the float from foot bridges in a sawing motion parallel to the direction in which the pavement is being laid from one side of the pavement to the other, and advancing not more than half the length of the float.
B. After the longitudinal floating is completed, but while the concrete is still plastic, eliminate minor irregularities in the pavement surfaces by means of metal floats, 1500 mm (5 feet) in length, and straightedges, 3000 mm (10 feet) in length. Make the final finish with the straightedges, which shall be used to float the entire pavement surface.
C. Test the surface for trueness with a 3000 mm (10 foot) straightedge held in successive positions parallel and at right angles to the direction in

which the pavement is being laid and the entire area covered as necessary to detect variations. Advance the straightedge along the pavement in successive stages of not more than one half the length of the straightedge. Correct all irregularities and refinish the surface.

D. The finished surface of the pavement shall not vary more than 6 mm (1/4 inch) in both longitudinal and transverse directions when tested with a 3000 mm (10 foot) straightedge.

E. The thickness of the pavement shall not vary more than 6 mm (1/4 inch).

F. When most of the water glaze or sheen has disappeared and before the concrete becomes nonplastic, give the surface of the pavement a broomed finish with an approved fiber broom not less than 450 mm (18 inches) wide. Pull the broom gently over the surface of the pavement from edge to edge. Brooming shall be transverse to the line of traffic and so executed that the corrugations thus produced will be uniform in character and width, and not more than 3 mm (1/8 inch) in depth. Carefully finish the edge of the pavement along forms and at the joints with an edging tool. The brooming shall eliminate the flat surface left by the surface face of the edger.

G. The finish surfaces of new and existing abutting pavements shall coincide at their juncture.

3.13 CONCRETE FINISHING EQUIPMENT PADS

A. After the surface has been struck off and screeded to the proper elevation, give it a smooth dense float finish, free from depressions or irregularities.

B. Carefully finish all slab edges with an edger having a radius as shown in the Drawings.

C. After removing the forms, rub the faces of the pad with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The finish surface of the pad shall not vary more than 3 mm (1/8 inch) when tested with a 3000 mm (10 foot) straightedge.

D. Correct irregularities exceeding the above.

3.14 JOINTS - GENERAL

A. Place joints, where shown, conforming to the details as shown, and perpendicular to the finished grade of the concrete surface.

B. Joints shall be straight and continuous from edge to edge of the pavement.

3.15 CONTRACTION JOINTS

A. Cut joints to depth as shown with a grooving tool or jointer of a radius as shown or by sawing with a blade producing the required width and depth.

B. Construct joints in curbs and gutters by inserting 3 mm (1/8 inch) steel plates conforming to the cross sections of the curb and gutter.

C. Plates shall remain in place until concrete has set sufficiently to hold its shape and shall then be removed.

D. Finish edges of all joints with an edging tool having the radius as shown.

E. Score pedestrian pavement with a standard grooving tool or jointer.

3.16 EXPANSION JOINTS

A. Use a preformed expansion joint filler material of the thickness as shown to form expansion joints.

B. Material shall extend the full depth of concrete, cut and shaped to the cross section as shown, except that top edges of joint filler shall be below the finished concrete surface where shown to allow for sealing.

C. Anchor with approved devices to prevent displacing during placing and finishing operations.

D. Round the edges of joints with an edging tool.

E. Form expansion joints as follows:

1. Without dowels, about structures and features that project through, into, or against any site work concrete construction.
2. Using joint filler of the type, thickness, and width as shown.
3. Installed in such a manner as to form a complete, uniform separation between the structure and the site work concrete item.

3.17 CONSTRUCTION JOINTS

A. Place transverse construction joints of the type shown, where indicated and whenever the placing of concrete is suspended for more than 30 minutes.

B. Use a butt-type joint with dowels in curb and gutter if the joint occurs at the location of a planned joint.

C. Use keyed joints with tiebars if the joint occurs in the middle third of the normal curb and gutter joint interval.

3.18 FORM REMOVAL

A. Forms shall remain in place at least 12 hours after the concrete has been placed. Remove forms without injuring the concrete.

B. Do not use bars or heavy tools against the concrete in removing the forms. Promptly repair any concrete found defective after form removal.

3.20 CURING OF CONCRETE

A. Cure concrete by one of the following methods appropriate to the weather conditions and local construction practices, against loss of moisture, and rapid temperature changes for at least seven days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. Provide protection as necessary to prevent cracking of the pavement due to temperature changes during the curing period. If any selected method of curing does not afford the proper curing and protection against concrete cracking, remove and replace the damaged pavement and employ another method of curing as directed by the COTR.

B. Burlap Mat: Provide a minimum of two layers kept saturated with water for the curing period. Mats shall overlap each other at least 150 mm (6 inches).

C. Impervious Sheeting: Use waterproof paper, polyethylene-coated burlap, or polyethylene sheeting. Polyethylene shall be at lease 0.1 mm (4 mils) in thickness. Wet the entire exposed concrete surface with a fine spray of water and then cover with the sheeting material. Sheets shall overlap each other at least 300 mm (12 inches). Securely anchor sheeting.

D. Liquid Membrane Curing:

1. Apply pigmented membrane-forming curing compound in two coats at right angles to each other at a rate of 5 m^2/L (200 square feet per gallon) for both coats.
2. Do not allow the concrete to dry before the application of the membrane.
3. Cure joints designated to be sealed by inserting moistened paper or fiber rope or covering with waterproof paper prior to application of the curing compound, in a manner to prevent the curing compound entering the joint.
4. Immediately re-spray any area covered with curing compound and damaged during the curing period.

3.21 CLEANING

A. After completion of the curing period:

1. Remove the curing material (other than liquid membrane).
2. Sweep the concrete clean.
3. After removal of all foreign matter from the joints, seal joints as herein specified.
4. Clean the entire concrete of all debris and construction equipment as soon as curing and sealing of joints has been completed.

3.22 PROTECTION

The contractor shall protect the concrete against all damage prior to final acceptance by the Government. Remove concrete containing excessive cracking, fractures, spalling, or other defects and reconstruct the entire section between regularly scheduled joints, when directed by the COTR, and at no additional cost to the Government. Exclude traffic from vehicular pavement until the concrete is at least seven days old, or for a longer period of time if so directed by the COTR.

3.23 FINAL CLEAN-UP

Remove all debris, rubbish and excess material from the Station.

- - - E N D - - -

SECTION 32 12 16
ASPHALT PAVING

~~SPEC WRITER NOTE: Delete or add information between // ---- // and any other items applicable to project. Any item added to the text shall be covered under Applicable Publications and Products and the paragraphs renumbered.~~

PART 1 - GENERAL

1.1 DESCRIPTION

This work shall cover the composition, mixing, construction upon the prepared subgrade, and the protection of hot asphalt concrete pavement. The hot asphalt concrete pavement shall consist of an aggregate or asphalt base course and asphalt surface course constructed in conformity with the lines, grades, thickness, and cross sections as shown. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

~~SPEC WRITER NOTE: The Designer and Spec Writer shall determine whether the State Highway Spec will be used or a new specification will be developed to cover the work of this Section. This guide specification is for use when the project requirements shall conform to the State Highway Spec. Highway spec must contain quality standards, percentage of compaction, and tests for quality and field and laboratory compaction. Where the Highway Spec calls for "Test", items "Designated", items to be "Established" and other such delegated duties to be performed by a State "Commission", "Engineer", "Laboratory" or other authorized agent; edit this spec to have responsibility for these items to be that of the Contractor. The Contractor shall retain and reimburse a laboratory to perform said duties; or to obtain a certification from the authorized representative of the State; or to obtain certification from the asphalt paving producer. Certificate of compliance shall cover quality and gradation of aggregate base, quality and grades of asphalt course materials, and that the job-mixture meets or exceeds the State requirements.~~

1.2 RELATED WORK

A. Laboratory and field testing requirements: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Subgrade Preparation: Paragraph 3.3 and Section 31 20 00, EARTH MOVING.

C. Pavement Markings: Section 32 17 23, PAVEMENT MARKINGS.

1.3 INSPECTION OF PLANT AND EQUIPMENT

The ~~Resident Engineer~~COTR shall have access at all times to all parts of the material producing plants for checking the mixing operations and materials and the adequacy of the equipment in use.

1.4 ALIGNMENT AND GRADE CONTROL

The Contractor's Registered Professional Land Surveyor specified in Section 00 72 00, GENERAL CONDITIONS shall establish and control the pavement (aggregate or asphalt base course and asphalt surface course) alignments, grades, elevations, and cross sections as shown on the Drawings.

1.5 SUBMITTALS

A. In accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish the following:

B. Data and Test Reports:

1. Aggregate Base Course: Sources, gradation, liquid limit, plasticity index, percentage of wear, and other tests required by State Highway Department.
2. Asphalt Base/Surface Course: Aggregate source, gradation, soundness loss, percentage of wear, and other tests required by State Highway Department.
3. Job-mix formula.

C. Certifications:

1. Asphalt prime and tack coat material certificate of conformance to State Highway Department requirements.
2. Asphalt cement certificate of conformance to State Highway Department requirements.

~~SPEC WRITER NOTE: Add required certification to Subparagraph 3.~~

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3. Job-mix certification - Submit plant mix certification that mix equals or exceeds the State Highway Specification.

D. One copy of State Highway Department Specifications.

E. Provide MSDS (Material Safety Data Sheets) for all chemicals used on ground.

PART 2 - PRODUCTS

2.1 GENERAL

A. ~~//~~ Aggregate base, ~~//~~ Asphaltic base ~~//~~ and asphalt concrete materials shall conform to the requirements of the following and other appropriate sections of the latest version of the State Highway Material Specifications, including amendments, addenda and errata. Where the term

"Engineer" or "Commission" is referenced in the State Highway Specifications, it shall mean the VA ~~Resident Engineer~~COTR or VA Contracting Officer.

~~SPEC WRITER NOTE: Add any construction requirements not adequately specified in the State Highway Spec.~~

2.2 AGGREGATES

A. Provide aggregates consisting of crushed stone, gravel, sand, or other sound, durable mineral materials processed and blended, and naturally combined.

B. Subbase aggregate (where required) maximum size: 38mm(1-1/2").

C. Base aggregate maximum size:

1. Base course over 152mm(6") thick: 38mm(1-1/2");
2. Other base courses: 19mm(3/4").

D. Asphaltic base course:

1. Maximum particle size not to exceed 25.4mm(1”).
2. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

E. Aggregates for asphaltic concrete paving: Provide a mixture of sand, mineral aggregate, and liquid asphalt mixed in such proportions that the percentage by weight will be within:

Sieve Sizes	Percentage Passing
19mm(3/4")	100
9.5mm(3/8")	67 to 85
6.4mm(1/4")	50 to 65
2.4mm(No. 8 mesh)	37 to 50
600µm(No. 30 mesh)	15 to 25
75µm(No. 200 mesh)	3 to 8

plus 50/60 penetration liquid asphalt at 5 percent to 6-1/2 percent of the combined dry aggregates.

2.3 ASPHALTS

A. Comply with provisions of Asphalt Institute Specification SS2:

1. Asphalt cement: Penetration grade 50/60
2. Prime coat: Cut-back type, grade MC-250
3. Tack coat: Uniformly emulsified, grade SS-1H

2.4 SEALER

A. Provide a sealer consisting of suitable fibrated chemical type asphalt base binders and fillers having a container consistency suitable for

troweling after thorough stirring, and containing no clay or other deleterious substance.

B. Where conflicts arise between this specification and the requirements in the latest version of the State Highway Specifications, the State Specifications shall control.

PART 3 - EXECUTION

3.1 GENERAL

The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.2 MIXING ASPHALTIC CONCRETE MATERIALS

A. Provide hot plant-mixed asphaltic concrete paving materials.

1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.
2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.

3.3 SUBGRADE

A. Shape to line and grade and compact with self-propelled rollers.

B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.

C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.

D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.

E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA ~~Resident Engineer~~COTR or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.4 BASE COURSES

A. Subbase (when required)

1. Spread and compact to the thickness shown on the drawings.
2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.

B. Base

1. Spread and compact to the thickness shown on the drawings.

2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.

C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").

D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer’s recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:
1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:
1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:
1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
a. No depressions which will retain standing water.
b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer’s recommendations as approved by the Architect or Engineer.

B. Apply one coat of the specified sealer.

C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

Formatted: Normal, None

~~**3.1 GENERAL**~~

~~The Asphalt Concrete Paving equipment, weather limitations, job-mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.~~

~~**3.2 MIXING ASPHALTIC CONCRETE MATERIALS**~~

~~A. Provide hot plant-mixed asphaltic concrete paving materials.~~

~~1. Temperature leaving the plant: 143 degrees C(290 degrees F) minimum, 160 degrees C(320 degrees F) maximum.~~

~~2. Temperature at time of placing: 138 degrees C(280 degrees F) minimum.~~

~~**3.3 SUBGRADE**~~

~~A. Shape to line and grade and compact with self-propelled rollers.~~

~~B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.~~

~~C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.~~

~~D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.~~

~~E. Proof-roll the subgrade with maximum 45 tonne (50 ton) gross weight dump truck as directed by VA Resident Engineer or VA Contracting Officer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.~~

~~**3.4 BASE COURSES**~~

~~A. Subbase (when required)~~

~~1. Spread and compact to the thickness shown on the drawings.~~

~~2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.~~

~~3. After completion of the subbase rolling there shall be no hauling over the subbase other than the delivery of material for the top course.~~

B. Base
1. Spread and compact to the thickness shown on the drawings.
2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.

C. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").

D. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

E. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.5 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:
1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C(280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:
1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:
1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown own the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
a. No depressions which will retain standing water.
b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.6 APPLICATION OF SEAL COAT

A. Prepare the surfaces, mix the seal coat material, and apply in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

B. Apply one coat of the specified sealer.

C. Achieve a finished surface seal which, when dry and thoroughly set, is smooth, tough, resilient, of uniform black color, and free from coarse textured areas, lap marks, ridges, and other surface irregularities.

3.7 PROTECTION

Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.8 FINAL CLEAN-UP

Remove all debris, rubbish, and excess material from the work area.

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SECTION 32 90 00
PLANTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing and installing all planting materials required for landscaping hereinafter specified in locations as shown.

1.2 EQUIPMENT

A. Maintain all equipment, tools and machinery while on the project in sufficient quantities and capacity for proper execution of the work.

1.3 RELATED WORK

A. Section 31 20 00, EARTH MOVING, Stripping Topsoil and Stock Piling.

B. Section 01 45 29, TESTING LABORATORY SERVICES, Topsoil Testing.

C. Section 31 20 00, EARTH MOVING, Topsoil Materials.

1.4 SUBMITTALS

A. Samples: Submit the following samples for approval before work is started:

Inert Mulch	2.3 kg (5 pounds) of each type to be used.
Organic Mulch	2.3 kg (5 pounds) of each type to be used.
All pesticides required such as pre emergence or post emergence herbicides, insecticides, or fungicides.	EPA approved labeling and MSDS sheet for each such product selected for use.
Plant Material	Provide digital image of each plant (tree, shrub) taken at nursery prior to digging. Image shall include the species and size. The image shall have sufficient clarity to see the complete form of the plant from the ground surface to the top of the plant.

B. Certificates of Conformance or Compliance: Before delivery, notarized certificates attesting that the following materials meet the requirements specified shall be submitted to the COTR for approval:

1. Plant Materials (Department of Agriculture certification by State Nursery Inspector from the state in which the plant material originates declaring material to be free from insects and disease).
2. Nursery acknowledgement for each plant including; species, genes, cultivar, size, quantity, and root condition.
3. Fertilizers
4. Lime
5. Peat

6. Sod - Certificates shall include information as to the kind/variety and purity of sod being shipped, field number and date of harvest, amount of sod shipped (square feet) and the net weight, quality compliance with recognized standards for noxious and objectionable weeds, and date of shipment. No sod may be laid until the Contractor has submitted the certificates.

C. Manufacturer's Literature and Data:
   1. Metal edging
   2. Antidesiccant
   3. Erosion control materials
   4. Pre-emergent herbicide
   5. Operation and Maintenance (O&M) Manuals

D. Licenses: Licenses of Arborist shall be submitted (one copy), to the COTR.

E. Soil laboratory testing results and any soil amendment recommendations noted as a result of analysis.
   1. Organic Soil Amendment and Imported Topsoil: The Contractor shall provide a one cubic foot representative sample from each proposed source for testing, analysis, and approval. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the COTR. Testing reports shall include the following tests and recommendations.
      a. Mechanical gradation (sieve analysis) and chemical (pH soluble salts) shall be performed by public extension service agency or a certified private testing laboratory in accordance with the current standards of the Association of Official Agricultural Chemists. A hydrometer shall be used to determine percent of clay and silt.
      b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
      c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Soluble Salts, and acidity (pH).
      d. Tests, as specified, for gradation, organics, soil chemistry and pH shall be performed by a testing laboratory retained by the Department of Veterans Affairs as described in Section 01410, TESTING LABORATORY SERVICES.
      e. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for fertilizing and liming applications to support successful turf growth.
      f. All tests shall be performed in accordance with the current standards of the Association of Official Agricultural Chemists.

2. Amended soil (in place): Following the incorporation of amendments and additives, the Contractor shall provide a minimum of six (6)samples per forty thousand (40,0000) square feet, six inch (6”) depth by three inch (3”) diameter core samples of amended soil taken from the site for testing, analysis, and approval. The location of each sample shall be as directed by the COTR from areas designated as “Lawn” or “Planting Bed” on the Contract Drawings. No turf restoration, nor planting, shall occur until acceptance of the amended soil samples has been obtained. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the COTR. Tests shall be as directed in paragraph 1.4 E.1.d. of this Section.
4. Fertilizer: Submit four (4) certificates of analysis for each type of fertilizer.

1.5 DELIVERY AND STORAGE

A. Delivery:
1. Notify the COTR of the delivery schedule in advance so the plant material may be inspected upon arrival at the job site. Remove unacceptable plant material from the job site immediately.
2. Protect plants during delivery to prevent damage to root balls or desiccation of leaves. Protect trees during transport by tying in the branches and covering all exposed branches.
3. The use of equipment such as "tree spades" is permitted provided the plant balls are sized in accordance with ANSI Z60.1 and tops are protected from damage.
4. Deliver fertilizer and lime to the site in the original, unopened containers bearing the manufacturer's warranted chemical analysis, name, trade name or trademark, and in conformance to state and federal law. In lieu of containers, fertilizer and lime may be furnished in bulk and a certificate indicating the above information shall accompany each delivery.
5. During delivery: Protect sod, from drying out.

B. Storage:
1. Sprinkle sod with water and cover with moist burlap, straw or other approved covering, and protect from exposure to wind and direct sunlight. Covering should permit air circulation to alleviate heat development.
2. Keep lime, and fertilizer in dry storage away from contaminants.
3. Store plants not installed on the day of arrival at the site as follows:
   a. Shade and protect plants from the wind when stored outside.
   b. Heel in bare root plants.
   c. Protect plants stored on the project from drying out at all times by covering the balls or roots with moist sawdust, wood chips, shredded bark, peat moss, or other similar mulching material.

d. Keep plants, including those in containers, in a moist condition until planted, by watering with fine mist spray.

1.6 PLANTING AND TURFGRASS INSTALLATION SEASONS AND CONDITIONS

A. Perform landscape planting operations within the following dates: From March 15th to May 15th for spring and from September 15th to November 15th for fall, but not before temporary irrigation system has been installed, tested, and approved.

B. Perform turfgrass installation operations within the following dates, but not before irrigation system installed, tested, and approved.
Turf (Sod) installation period: May 15th to September 15th.

C. No work shall be done when the ground is frozen, snow covered, too wet or in an otherwise unsuitable condition for planting. Special conditions may exist that warrants a variance in the specified planting dates or conditions. Submit a written request to the COTR stating the special conditions and proposal variance for approval.

1.7 LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD

A. The Establishment Period for landscape plants and turf shall begin immediately after installation, with the approval of the COTR, and continue for a minimum of five (5) months or one full growing season. When the five (5) month establishment period can not be achieved during the current growing season, the establishment period shall continue to the next growing season and shall begin again for a full three (3) months to ensure that the plants remain healthy and vigorous after overwintering. The contractor shall be responsible for the health and maintenance of plants and turf between growing seasons. Plants and turf will not be accepted until after completion of the establishment period.

1. Water all plants and turfgrass to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of 25 mm (1 inch) of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch, create any water ponding or runoff from the soil supporting the plants and turf.
2. Prune plants and replace mulch as required.
3. Replace and restore stakes, guy straps, and eroded plant saucers as required.
4. In plant beds and saucers, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 75 mm (3 inches). After all unwanted vegetation has been removed and proper mulch quantities have been placed/restored, treat all mulched areas with pre-emergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination.

5. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, as directed by the COTR in coordination with the MSN Agronomist.
6. Provide the following during turfgrass establishment:
   a. Eradicate all weeds. Water, fertilize, resod, and perform any other operation necessary to promote the growth of turfgrass.
   b. Mow the turfgrasses at least three times prior to final acceptance. Begin mowing when cool season turfgrass is 100 mm (4 inches) high. For warm season turfgrass mow as follows: Hybrid bermuda grass cultivars – 1.5 inches. Mow warm season turfgrass as often as necessary to maintain the proper height while never removing more than 1/3 of the height of new growth in a single mowing. Mow any portion of the newly turfgrass area that requires mowing without waiting for other areas of slowly developing seedlings to catch-up.
7. Replace dead, missing or defective plant material during the establishment period. Immediately replace each plant with one of the same size and species.
8. Replant (with sod) any areas void of turfgrass.
   a. Sod shall be evaluated for species and health thirty (30) days after laying the last piece of sod and reevaluated each 15 days during the establishment period. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth. Unsatisfactory areas shall be resodded within seven (7) days.
9. Complete remedial measures directed by the COTR in coordination with the MSN Agronomist to ensure plant and turfgrass survival.
10. Repair damage caused while making plant or turfgrass replacements.

1.8 LANDSCAPE PLANT AND TURF ACCEPTANCE.

A. Landscape plant and turf acceptance will occur after completion of the LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD. The Contractor shall have completed, located, and installed all plants and turfgrass according to the plans and specifications. All plants and turfgrass are expected to be living and in a healthy condition at the time of inspection and acceptance. The Contractor shall make a written request for final inspection of the landscape plants and turf. Upon inspection when work is found to not meet design intent and specifications, the PLANT AND TURF ESTABLISHMENT PERIOD shall be extended at no additional cost to the Government until work has been satisfactorily completed, inspected and accepted.

B. Criteria for acceptance of landscape plants.
   1. Planter beds and earth mound water basins are properly mulched and free of weeds.

2. Tree support stakes, guys, and turnbuckles are in good condition.
3. Total plants on site as required by specifications and required number of replacements have been installed.
4. Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

C. Criteria for acceptance of turfgrass shall be as follows:
1. A satisfactory stand of grass plants from the sod operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum two (2) square inches. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

1.9 PLANT AND TURF WARRANTY

A. All work shall be in accordance with the terms of the Paragraph, "Warranty" of Section 00 72 00, GENERAL CONDITIONS, including the following supplements:
1. A One Year Plant and Turf Warranty will begin on the date that the Government accepts the plants and turf but not before the end of the Landscape Plant and Turf Establishment Period.
2. The Contractor will replace any dead plant material and any areas void of turfgrass immediately during the warranty period. A one year warranty for the plants and turfgrass that are replaced will begin on the day the replacement work is accepted.
3. Replacement of relocated plants, that the Contractor did not supply, is not required unless they die from improper handling and care during transplanting. Loss through Contractor improper handling, care, or negligence requires replacement in kind and size.
4. The Government will reinspect all plants and turf at the end of the One Year Warranty. The Contractor will replace any dead, missing, or defective plant material and turfgrass immediately. The Warranty will end on the date of this inspection provided the Contractor has complied with the work required by this specification.
5. The Contractor shall remove stakes, guy straps and any required tree wrappings from plants having been installed for one year.

1.10 OPERATION AND MAINTENANCE (O&M) MANUALS.

A. Submit five (5) copies of the Operation and Maintenance (O&M) Manuals for planting materials at the beginning of the LANDSCAPE PLANT AND TURF ESTABLISHMENT PERIOD. Include instructions indicating procedures during one typical year including variations of maintenance for climatic conditions throughout the year. Provide instructions and procedures for watering; promotion of growth, including fertilizing, pruning, and mowing; and integrated pest management.

B. O&M Manuals shall include pictures of planting materials cross referenced to botanical and common names, with a description of the normal appearance in each season.

C. Develop a water monitoring program for surface and ground water on the project site in accordance with ASTM D 5851 and consistent with the water management program utilized during construction operations.

1.11 APPLICABLE PUBLICATIONS

A. NCA Handbook 3420 – Turfgrass Maintenance in VA National Cemeteries re-certified July 2008. The Agronomic and Horticultural practices specified in this handbook shall serve as the contractor’s official guide to all establishment and preliminary maintenance practices employed during this construction project.

B. Specific to U.S. Dept. of Veterans Affairs and National Cemetery Administration the document titled “Cemetery Construction Requirements for Turfgrass and Landscape Plant Material Installation” Appendix TL as attached to this specification shall serve as contractor’s exclusive guide for this construction project.

C. The publications listed below, form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

D. American National Standards Institute (ANSI) Publications:

ANSI Z60.1-04	Nursery Stock
ANSI Z133.1-06	Tree Care Operations-Pruning, Trimming, Repairing, Maintaining, and Removing Trees and Cutting Brush-Safety Requirements

E. Hortus Third, A Concise Dictionary of Plants Cultivated in the U.S. and Canada.

F. American Society for Testing and Materials (ASTM) Publications:

C136-06	Sieve Analysis of Fine and Coarse Aggregates
C516-08	Vermiculite Loose Fill Thermal Insulation
C549-06	Perlite Loose Fill Insulation
D1557-09	Test Methods for Laboratory Compaction of Soil
D5851 (Rev 2006)	Planning and Implementing a Water Monitoring Program

G. Turfgrass Producers International:
Turfgrass Sodding.

H. U. S. Department of Agriculture Federal Seed Act.

1998	Rules and Regulations

PART 2 - PRODUCTS

2.1 GENERAL

A. All plant and turfgrass material will conform to the varieties specified or shown in the plant list and be true to botanical name as listed in Hortus Third.

2.2 ORGANIC SOIL AMENDMENT

A. Existing topsoil on site will not be stripped and stockpiled since its organic content is low, unless otherwise directed by the COTR, or if topsoil layer contains greater than eight percent (8%) organic material. All areas to receive lawn or meadow seeding will require an organic soil amendment to increase organic content and water retention as well as enhance turf growth. Soils will be amended in-place after grading activities are completed to effectively create a topsoil horizon.

B. Organic soil amendment will be spread and incorporated into the finished subgrade at the depths indicated on the Contract Drawings in order to raise the organic content of the soil to a minimum of four percent (4%) and a maximum of six percent (6%). Contractor will allow for additional depth of the organic soil amendment to bring all grades to the required finished grades as per the grading plans.

1. Organic Soil Amendment shall be dark brown or black in color and capable of enhancing plant growth. Ninety-eight percent (98%) of the material should pass a one inch (1”) screen. There shall be no admixture of refuse (i.e. noticeable inert contamination) or other materials toxic to plant growth.
2. Acceptable types of Organic Soil Amendments include peat moss, humus or peat, well rotted manure, various mature composts, and commercially available combinations thereof. Acceptable compost may be derived from natural organic sources such as food or animal residuals, yard trimmings, or biosolids. Organic Soil Amendment shall be free of all woody fibers, seeds, and leaf structures, plastic and other petroleum products, and free of toxic and non-organic matter. Unacceptable sole sources of organic matter include untreated sludge from wastewater treatment plants, fresh manure, sawdust, and immature composts.
3. Organic Soil Amendment shall conform to the following minimum material requirements:

Test Parameter	Acceptable Ranges
Organic Matter	27% to 80%
pH	5.5-8.5
Ash	20-65%
Nitrogen	0.4%-3.5%
Phosphorus	0.2%-1.5%
Potassium	0.4%-1.5%

C:N Ratio	25-30:1
CEC	50-150 meq/100 g
Heavy Metals	Less than max. limits established by EPA 503
Inert Contents	< 1% by weight
Water-Holding Capacity	150-200%
Pathogen/Weed Seed Destruction	Proof of EPA minimum Heating requirements

4. Organic content to be determined by the loss of ignition of oven-dried samples. Test samples shall be oven-dried to a constant weight at a temperature of 110 °C, plus or minus 5°C.
5. Any topsoil stripped and stockpiled on the site may be used provided that, after testing and addition of necessary additives, it meets the above specification. The Contractor shall provide additional Organic Soil Amendment as required to complete the required work.
6. All Organic Soil Amendment proposed for use shall be tested for conformance to the specifications.

2.3 PLANTS

A. Plants shall be in accordance with ANSI Z60.1, except as otherwise stated in the specifications or shown on the plans. Where the drawings or specifications are in conflict with ANSI Z60.1, the drawings and specification shall prevail.

B. Provide well-branched and formed planting stock, sound, vigorous, and free from disease, sunscald, windburn, abrasion, harmful insects or insect eggs with healthy, normal, and unbroken root systems. Provide trees, deciduous and evergreen, that are single trunked with a single leader, unless otherwise indicated, display no weak crotches. Provide symmetrically developed deciduous trees and shrubs of uniform habit of growth, with straight boles or stems and free from objectionable disfigurements, and evergreen trees and shrubs with well developed symmetrical tops with typical spread of branches for each particular species or variety. Provide ground cover and vine plants with the number and length of runners for the size specified, and the proper age for the grade of plants specified. Provide vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Spray all plants budding into leaf or having soft growth with an anti-desiccant at the nursery before digging.

C. The minimum acceptable sizes of all plants, measured before pruning with branches in normal position, shall conform to the measurements designated. Plants larger in size than specified may be used with the approval of the

COTR, with no change in the contract price. When larger plants are used, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

D. Provide nursery grown plant material conforming to the requirements and recommendations of ANSI Z60.1. Dig and prepare plants for shipment in a manner that will not cause damage to branches, shape, and future development after planting.

E. Balled and burlapped (B&B) plant ball sizes and ratios will conform to ANSI Z60.1, consisting of firm, natural balls of soil wrapped firmly with burlap or strong cloth and tied.

F. Bare-root (BR) plants shall have the root system substantially intact, but with the earth carefully removed. Cover roots with a thick coating of mud by "puddling" after the plants are dug.

G. Container grown plants shall have sufficient root growth to hold the earth intact when removed from containers, but shall not be root bound.

H. Make substitutions only when a plant (or its alternates as specified) is not obtainable and the COTR in coordination with the MSN Agronomist authorizes a change order providing for use of the nearest equivalent obtainable size or variety of plant having the same essential characteristics with an equitable adjustment of the contract price.

I. When existing plants are to be relocated, ball sizes shall conform to requirements for collected plants in ANSI Z60.1, and plants shall be dug, handled, and replanted in accordance with applicable sections of these specifications.

2.4 LABELS

A. Each plant, or group and bundles or containers of the same species, variety, and size of plant, shall be legibly tagged with a durable, waterproof and weather-resistant label indicating the correct plant name and size specified in the plant list. Labels shall be securely attached and not be removed.

2.5 TOPSOIL

A. Topsoil shall be a well-graded soil of good uniform quality. It shall be a natural, friable soil representative of productive soils in the vicinity. Topsoil shall be free of admixture of subsoil, foreign matter, objects larger than 25 mm (one inch) in any dimension, toxic substances, weeds and any material or substances that may be harmful to plant growth and shall have a pH value of not less than 5.3 nor more than 6.0, and should be best suited to the region, climate and plant material specific to the project.

B. Obtain material from stockpiles established under Section 31 20 00, EARTH MOVING, subparagraph, Stripping Topsoil that meet the general requirements as stated above. Amend topsoil not meeting the pH range specified by the addition of pH Adjusters.

C. If sufficient topsoil is not available on the site to meet the depth as specified herein, the Contractor shall furnish additional topsoil. At least 10 days prior to topsoil delivery, notify the COTR of the source(s) from which topsoil is to be furnished. Obtain topsoil from well drained areas. Additional topsoil shall meet the general requirements as stated above and comply with the requirements specified in Section 01 45 29, TESTING LABORATORY SERVICES. Amend topsoil not meeting the pH range specified by the addition of pH adjusters.

2.6 LIME

A. Lime shall be agricultural limestone containing not less than 90 percent calcium and magnesium carbonates. Lime must be ground to such fineness that not less than 90% must pass No. 8 mesh and not less than 25% must pass No. 100 mesh. Moisture is not to exceed 10%.

2.7 SOIL CONDITIONERS

A. Peat shall be a natural product of sphagnum moss peat (peat moss) derived from a fresh-water site conforming to Fed. Spec. Q-P-166, except as otherwise specified. Peat shall be shredded and granulated to pass through a 13 mm (1/2inch) mesh screen and conditioned in storage piles for at least six months after excavation.

B. Coarse Sand

1. Coarse concrete sand, ASTM C-33 Fine Aggregate, shall be clean, sharp, and free of limestone, shale and slate particles and of toxic materials.

C. Perlite shall conform to ASTM C549.

D. Vermiculite shall be horticultural grade and free of any toxic materials and conform to ASTM C516.

E. Pine Bark shall be horticultural-grade milled pine bark, with 80 percent of the material by volume sized between 0.1 and 15.0 mm. (.004in. and .59in.).

1. Pine bark shall be aged sufficiently to break down all woody material. Pine bark shall be screened
2. pH shall range between 4.0 and 7.0.
3. Submit manufacturer’s literature for approval.

F. Organic Matter shall be commercially prepared compost, composted sufficiently to be free of all woody fibers, seeds, and leaf structures, and free of toxic and nonorganic matter.

2.8 PLANTING SOIL MIXTURE

A. The planting soil mixture for shrub beds and tree pits shall be composed of one part topsoil two parts amended native soil excavated from the planting pits and plant beds and one part peat mixed with fertilizer determined by testing laboratory.

2.9 PLANT FERTILIZERS

A. Provide plant fertilizer that is commercial grade and uniform in composition and conforms to applicable state and federal regulations.

B. For new plant material, provide a uniform free-flowing granular complete analysis fertilizer containing a minimum of 10% by weight of nitrogen, phosphoric acid and potash with a minimum of 50% of the nitrogen from a controlled release source such as sulfur coated urea.

C. For existing trees, provide a uniform free-flowing granular fertilizer bearing the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 10% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea.), 10% available phosphoric acid, and 10% potash.

2.10 TURFGRASS FERTILIZER

A. Provide turfgrass fertilizer that is commercial grade, free flowing, uniform in composition, and conforms to applicable state and federal regulations. Granular fertilizer shall bear the manufacturer's warranted statement of analysis. Granular fertilizer shall contain a minimum percentage by weight of 20% nitrogen (of which 50 percent shall be from a controlled release source such as sulfur coated urea), 5% available phosphoric acid, and 15% potash.

B. Upon receipt of the soil analyses required herein, Contractor is to verify percent composition of all turfgrass fertilizer with county extension office. Composition shall be 20-5-5 unless otherwise determined by the testing laboratory or as directed by COTR.

2.11 MEMBRANES

A. Landscape Fabric shall be a woven needle-punched polypropylene weighing 113 grams per square meter (4.8 oz. per sq. yd.) And a 950 liter per minute flow rate per sq. meter. (90 gal. per minute flow rate per sq. ft.).

2.12 MULCH

A. Mulch shall be free from deleterious materials and shall be stored as to prevent inclusion of foreign material.

B. Inert mulch materials shall be riverbank stone, granite chips or marble chips or similar and shall range in size from 3 mm (1/8 inch) to 10 mm (3/8 inch) in accordance with ASTM C 136.

C. Organic mulch materials shall be finely shredded, processed hardwood bark common to the locality and free from foreign materials and fragments. Bark shall be of a relative particle size with a median size of 40 mm (1 1/2 inches) with none in excess of 50 mm (2 inches) in any dimension.

2.13 EROSION CONTROL

A. Erosion control net material for tree and shrub plant beds shall be heavy, twisted jute mesh weighing 59 Kg (130 pounds) per spindle of 13,200 meters (14,400yards) and consisting of loosely twisted fibers having a minimum average twist of 1.6 turns per 25 m and that does not vary in thickness by

more than half its normal diameter. Mesh width; 1200 mm (48 inches) plus or minus 25 mm (1 inch). Material will be secured with 150 mm (6 inch) wire staples made by the same manufacturer as the netting. All erosion control material is to be installed according to the respective manufacturer's recommendations.

2.14 TREE WRAP

A. Breathable synthetic fabric tree wrap. White in color, delivered in 75 mm (3 in.) wide rolls, specifically manufactured for tree wrapping. Tree wrap shall be "Breathable Fabric Tree Wrap" as manufactured by the Dewitt Company, Inc., Sikeston, MO, or approved equal. Submit manufacturer literature for approval.

2.15 TREE WOUND DRESSING

A. Tree paint shall be waterproof, asphalt base paint with antiseptic properties for use on tree wounds and shall be Toch Bros. R.1.W. Tree Surgery Paint, Sherwin Williams Pruning Compound or approved equal.

2.16 STAKES AND GUYING STRAPS

A. Provide stakes for tree support of rough sawn wood, free from knots, rot, cross grain, or other defects that would impair the strength. Stakes shall be a minimum of 50 mm by 50 mm (2 inches by 2 inches), or 65 mm (2-1/2 inches) in diameter, by 2400 mm (8 feet) long and pointed at one end galvanized steel pipe 32 mm (1 ¼ in.) x 3000 mm (10’) with cap, primed with 2 coats flat black exterior enamel.

B. Guying wire shall be 2.7 mm (12 gage) annealed galvanized steel.

C. Hose chafing guards shall be new or used 2-ply reinforced rubber or plastic hose of all the same color on the project.

D. Flags to be fastened to guys shall be surveyor's plastic tape, white in color and 150 mm (6 inches) in length.

E. Guying straps shall be a fabric material designed specifically to guy newly planted trees. No wire should ever be used for this purpose.

F. Turnbuckles shall be galvanized or cadmium-plated and have a 75 mm (3 inch) minimum lengthwise opening fitted with screw eyes.

G. Eye bolts shall be galvanized or cadmium plated having a 50 mm (one inch) diameter eye with a minimum screw length of 40 mm (1-1/2 inches).

H. Deadmen shall be 50 mm by 100 mm (2 inch by 4 inch) rectangular (36 inch) long sound wood.

2.17 EDGING

A. Metal edging shall be galvanized steel or aluminum with slots provided for stakes and shall be 5 mm (3/16 inch) thick by 125 mm (5 inches) deep in standard lengths. Steel edging shall be treated with a rust preventative coating and factory finished in color black. Anchoring stakes shall be of similar material and 400 to 450 mm (16 to 18 inches) long and tapered.

2.18 WATER

A. Water shall not contain elements toxic to plant life. Water for purposes of temporary irrigation may be obtained from the source/hose bib located within the adjacent service yard and/or temporary hose bib to be installed as part of project. As this source is schedule to be relocated as part of this contact the Contractor is to coordinate the landscape operations and water needs with the relocation efforts, so as not to deprive any plant materials of the required supplemental water.

B. Water for temporary irrigation as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, Temporary Services will be available at no cost to the Contractor.

2.19 ANTIDESICCANT

A. Antidesiccant shall be an emulsion specifically manufactured for agricultural use that will provide a protective film over plant surfaces permeable enough to permit transpiration.

2.20 SOD

A. Sod shall be nursery grown, certified sod as classified in the TPI Guideline Specifications to Turfgrass Sodding.

B. All Sod shall be Tifway 419 Bermuda Grass of premium quality and capable of meeting the aforementioned certification standards addressing purity of the stand and freedom from noxious weeds or excessive amounts of other crop materials.

C. All turfgrass sod composition shall conform to the species and cultivar requirements detailed in Appendix TL for NCA Cemetery Construction Requirements. Any deviation from these turfgrass species requirements must be approved in writing by the NCA Chief Agronomist and/or appropriate MSN Agronomist in coordination with the COTR and/or COTR.

2.21 HERBICIDES AND OTHER PESTICIDES

A. All herbicides and other pesticides shall be properly labeled and registered with the U.S. Environmental Protection Agency. Keep all pesticides in the original labeled containers indicating the analysis and method of use.

PART 3 – EXECUTION

APPENDIX TL, "MASTER SPECIFICATIONS FOR NCA CEMETERY CONSTRUCTION, U.S. DEPARTMENT OF VETERANS AFFAIRS, NATIONAL CEMETERY ADMINISTRATION, CEMETERY CONSTRUCTION REQUIREMENTS FOR TURFGRASS AND LANDSCAPE PLANT MATERIAL INSTALLATION" SHALL BE THE OPERATIONAL GUIDE FOR THE FOLLOWING SPECIFICATION PARAGRAPHS 3.1 – 3.23. ANY CONFLICTS IN WORDING OR INTERPRETATION SHALL DEFAULT TO APPENDIX TL.

3.1 LAYOUT

A. Stake plant material locations and bed outlines on project site for approval by the COTR before any plant pits or beds are dug. The COTR may approve adjustments to plant material locations to meet field conditions.

3.2 FINE GRADING AND ORGANIC SOIL AMENDMENT INCORPORATION

A. Contractor shall obtain COTR's written approval of previously completed rough grading work prior to commencing organic soil amendment incorporation work.

B. Immediately prior to dumping and spreading the approved organic soil amendment, the subgrade shall be cleaned of all stones greater than two inches (2") and all debris or rubbish. Such material shall be removed from the site. Prior to spreading of the organic soil amendment, subgrades which are too compact to drain water and too compact based upon compaction tests shall be ripped with a claw one foot (1') deep, pulled by a bulldozer two feet (2') on center, both directions. Contractor shall then regrade surface.

C. Organic soil amendment material shall be placed and uniformly spread over approved finish sub-grades to a depth sufficiently greater than the specified depth so that after natural settlement and light rolling, the specified minimum compacted depth will have been provided and the completed work will conform to the lines, grades and elevations indicated. Incorporate organic soil amendment by disc harrowing, rototilling or other means in a uniform manner. The depth of incorporation shall be based upon the organic content of the tested and approved organic soil amendment, so as to produce a finished soil with an organic matter content of between four (4) and six percent (6%). Supply additional organic soil amendment material, after in-place testing and approval (see paragraph 1.4. E.1d), as may be needed to give the required organic matter content and finished grades under the Contract without additional cost to the Government.

D. Disturbed areas outside the limit of work shall be spread with four inch (4") minimum depth of organic soil amendment material to the finished grade.

E. No subsoil or organic soil amendment material shall be handled in any way if it is in a wet or frozen condition.

F. Sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Connect contours and spot elevations with an even slope.

G. After organic soil amendment material has been incorporated into the subsoil, it shall be carefully prepared by scarifying or harrowing and hand raking. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove all stones over one and one half inch (1-1/2") diameter from the amended soil bed. The amended soil shall also be free of smaller stones in excessive quantities as determined by the COTR.

H. The whole surface shall then be compacted with a roller or other suitable means to achieve a maximum dry density of 88 to 90 percent in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional organic soil amendment and the surface shall be regraded and

rolled until presenting a smooth and even finish corresponding to the required grades.

3.3 EXCAVATION FOR PLANTING

A. Prior to excavating for plant pits and bed, verify the location of any underground utilities. Damage to utility lines will be repaired at the Contractor's expense. Where lawns have been established prior to planting operation, cover the surrounding turfgrass before excavations are made in a manner that will protect turfgrass areas. Barricade existing trees, shrubbery, and beds that are to be preserved in a manner that will effectively protect them during the project construction.

B. Remove rocks and other underground obstructions to a depth necessary to permit proper planting according to plans and specifications. Where underground utilities, construction, or solid rock ledges are encountered, the COTR may select other locations for plant material.

C. Dig plant pits by any approved method so that they have vertical sides and flat bottoms. When pits are dug with an auger and the sides of the pits become glazed, scarify the glazed surface. See Appendix TL for required planting instructions for all container grown, balled and burlapped or boxed plants.

D. Where ground cover and planting beds occur in existing turfgrass areas, remove turfgrass to a depth that will ensure the removal of the entire root system, with additional bed preparation as specified in the next paragraph.

E. Excavate all shrub beds and tree planting pits and replace with the specified well blended planting soil mixture. Lightly compact to prevent settlement of the mixture after planting.

F. In areas of new grading where existing soil is being replaced for the construction of new ground cover and plant beds, remove 100 mm (4 inches) of existing soil and replace with topsoil. Plant beds shall be brought to a smooth and even surface conforming to established grades. Till 50 mm (2 inches) of peat soil amendment into the topsoil as specified.

G. Using topsoil, form earth saucers or water basins for watering around plants. Basins to be 2″ high for shrubs and 4″ high for trees.

H. Treat plant saucers, shrub, and ground cover bed areas, after mulching, with preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Plant ground cover in areas to receive erosion control material through the material after material is in place.

3.4 SETTING PLANTS

A. Handle balled and burlapped and container-grown plants only by the ball or container. Remove container-grown plants in such a way to prevent damage to plants or root system. Set plants plumb and hold in position until sufficient soil has been firmly placed around the roots or ball. Set plants

so that the root crown is 1” higher than the surrounding grade. Plant ground cover plants after the mulch is in place. Avoid contaminating the mulch with the planting soil.

B. Backfill balled and burlapped and container-grown plants with planting soil mixture as specified to approximately half the depth of the ball and then tamp and water. It is desirable to use approximately 75 percent native soil to backfill the hole, but do not use unsuitable fill containing clay, rock or other unsuitable material. Ideally, backfill should be a 25%-75% mixture of peat moss and clean, screened, native topsoil which will allow for proper drainage of water in the planting hole. For balled and burlapped plants, carefully remove excess burlap and tying materials and fold back. Any wire caging or similar material, must be completely removed. Where plastic wrap or treated burlap is used in lieu of burlap, completely remove these materials before backfilling. Tamp and water remainder of backfill Planting Soil Mixture; then form earth saucers or water basins around isolated plants with topsoil.

C. Plant bare-root stock arranging the roots in a natural position. Form a hill or mound in the center of the planting hole to allow the plant to sit at the proper depth. The roots are then spread out, over, and down the “hill” in a natural position. The “hill” should be firm to avoid settlement of the entire plant. Remove damaged roots with a clean cut. Carefully work Planting Soil Mixture in among the roots. Tamp and water the remainder of Planting Soil Mixture; then form earth saucers or water basins around isolated plants with topsoil.

3.5 TRUNK WRAPPING

A. Wrap the trunks of deciduous trees immediately after planting. Wrap the trunks of deciduous trees, 40 mm (1-1/2 inches) or greater in caliber with the specified material beginning at the base and extending to the first branches. Remove wrapping after one year.

3.6 STAKING AND GUYING

A. Stake and guy plants as shown on the drawings and as specified.

B. Drive stakes vertically into the ground to a depth of 800 to 900 mm (2-1/2 to 3 feet) in such a manner as not to injure the ball or roots, unless otherwise shown on the drawings.

C. Place deadmen not less than 450 mm (18 inches) below the surface of the ground, unless otherwise shown on the drawings.

D. Fasten flags securely on each guy strap approximately 2/3 of the distance up from ground level.

E. Remove stakes and guy straps after one year.

3.7 EDGING PLANT BEDS

A. Uniformly edge beds using a sharp tool to provide a clear cut division line between the planted area and the adjacent turfgrass.

B. Install metal edging materials in accordance with manufacturer’s recommendations and as shown on drawings.

3.8 MULCHING PLANTS

A. Mulch within 48 hours after planting and apply a preemergence granular ornamental herbicide containing 2.0% trifluralin and 0.5% isoxaben. Apply at 200 lb per acre prior to both early spring and early fall weed seed germination. Do not mulch in ground cover areas that shall have organic material placed before planting.

B. Placing Inert Material: Place polyethylene sheet fiberglass mat Landscape fabric with edges lapped 150 mm to 300 mm (6 inches to 12 inches) to receive inert mulch material. Punch a grid of 6 mm (1/4 inch) holes for drainage in the polyethylene sheet fiberglass mat 300 mm (one foot) on centers over the entire area. Spread inert mulch to a uniform thickness over the membrane as shown.

C. Placing Organic Material: Spread a mulch of wood based origin to a uniform minimum thickness of 50 mm (2 inches).

D. Keep mulch out of the crowns of shrubs and off buildings, sidewalks, light standards, and other structures.

3.9 PRUNING

A. Prune new plant material and indicated existing plant material in the following manner: Remove dead, broken and crossing branches. Prune balled and burlaped deciduous trees and shrubs to reduce total amount of anticipated foliage by 1/4 to 1/3 while retaining typical growth habit of individual plants with as much height and spread as is practicable. Such pruning should not be done on container-grown plants.

B. Make cuts with sharp instruments as close as possible to the branch collar. Do not make flush cuts. Do not make "Headback" cuts at right angles to line of growth. Do not pole trees or remove the leader.

C. Remove trimmings from the site.

D. Paint cuts 13 mm (1/2 inch) in diameter and larger with the specified tree wound dressing.

3.10 FERTILIZATION OF EXISTING TREES

A. Apply fertilizer to existing trees shown on the drawings at the rate of 36 g/mm (2 pounds per inch) caliper. Apply in 300 mm to 450 mm (12 inch to 18 inch) deep holes 40 to 50 mm (1-1/2 to 2 inches) in diameter, made by an earth auger, distributed evenly at not more than 600 mm (2 feet) on center throughout the outer half of the branch spread zone of each tree. Fertilize to within 100 mm (4 inches) of the surrounding grade. Use topsoil to bring the surface up to the surrounding grade.

B. When using fertilizer in packet, tablet, or wedge form, apply in accordance with manufacturer's recommendations.

3.11 TILLAGE FOR TURFGRASS AREAS

A. Thoroughly till the soil to a depth of at least 150 mm (6 inches) by scarifying, disking, harrowing, or other approved methods. This is particularly important in areas where heavy equipment has been used, and especially under wet soil conditions.

B. Remove all debris and stones larger than 25 mm (one inch) remaining on the surface after tillage in preparation for finish grading.

C. To minimize erosion, do not till areas of 3:1 slope ratio or greater. Scarify these areas to a 50 mm (one inch) depth and remove debris and stones.

3.12 FINISH GRADING

A. After tilling the soil for bonding of topsoil with the subsoil, spread the topsoil evenly to a minimum depth of 100 mm (4 inches). Incorporate topsoil at least 50 to 75 mm (2 to 3 inches) into the subsoil to avoid soil layering.

B. Do not spread topsoil when frozen or excessively wet or dry.

C. Correct irregularities in finished surfaces to eliminate depressions.

D. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

E. Complete lawn work only after areas are brought to finished grade.

3.13 APPLICATION OF FERTILIZER AND LIME FOR TURF AREAS

A. Apply turf fertilizer at a rate that will deliver 1 pound of nitrogen per 1000 sq.ft. In addition, adjust soil acidity as recommended by soil test results and add any soil conditioners as specified herein for suitable topsoil under PART 2, Paragraph, and TOPSOIL.

B. Contractor is to coordinate required application of lime at rate (pounds per 1,000 square feet) determined by laboratory analysis and the soil testing required herein and/or as directed by COTR.

C. Incorporate lime into the soil to a depth of at least 100 mm (4 inches) as part of the finish grading operation. Starter fertilizer should be lightly mixed with the top ½ inch of soil. Immediately restore the soil to an even condition before any seeding or sod placement.

3.14 SODDING

A. Accomplish sodding in accordance with the ASPA Guideline Specifications for sodding. Lay sod at right angles to slope or the flow of water. On slope areas, start at the bottom of the slope.

B. After completing the sodding operation, blend the edges of the sodded area smoothly into the surrounding area. All sod should be rolled after being laid to eliminate air spaces between the sod and the firmed soil.

3.15 WATERING

A. Apply water to the turfgrass areas immediately following installation at a rate sufficient to ensure thorough wetting of the soil to a depth of at least

50 mm (2 inches). Supervise watering operation to prevent run-off. Supply all pumps, hoses, pipelines, and sprinkling equipment. Repair all areas damaged by water operations.

D. Contractor shall deep water all trees twice each week during the Plant Establishment Period, providing water penetration throughout the root zone to the full depth of the planting pits, as verified in the field by the COTR. Watering shall cease at the first hard frost in the fall and shall resume upon ground thaw in the spring.

E. Contractor shall provide supplemental water, as needed and determined by actual weekly precipitation recorded at the project location, to all restored turf grass areas, trees, shrubs and bedding plants to maintain the health and vigor of each throughout the establishment period defined by these specifications.

F. Damages to landscape materials (dieback, wilt, stress, death, etc.) resulting from inadequate application of supplemental water during the establishment period will be the sole responsibility of the Contractor. Plant materials exhibiting signs of distress due to lack of water will be replaced by the Contractor at no additional cost to the Government.

3.16 PROTECTION OF TURFGRASS AREAS

A. Immediately after installation of the turfgrass areas, protect against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

3.17 RESTORATION AND CLEAN-UP

A. Where existing or new turfgrass areas have been damaged or scarred during planting and construction operations, restore disturbed area to their original condition. Keep at least one paved pedestrian access route and one paved vehicular access route to each building clean at all times. In areas where planting and turf work have been completed, clear the area of all debris, spoil piles, and containers. Clear all other paved areas when work in adjacent areas are completed. Remove all debris, rubbish and excess material from the station.

3.23 ENVIRONMENTAL PROTECTION

A. All work and Contractor operations shall comply with the requirements of Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS.

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Appendix - TL

Master Specifications for NCA Cemetery Construction

U.S. Department of Veterans Affairs

National Cemetery Administration

Cemetery Construction Requirements for Turfgrass and Landscape Plant Material Installation

(Updated July 2008 by NCA Chief Agronomist, Dr. Tom Perkins)

General Requirements

1. Existing Conditions: The Landscape Contractor shall be required to visit the site prior to submitting Bid Proposal to become familiar with all conditions affecting the proposed work. The Landscape Contractor shall identify and review all underground utility locations prior to commencing work and shall exercise extreme caution when working close to utilities and shall notify the COTR and/or Contracting Officer's Technical Representative (COTR) of apparent conflicts with construction and utilities so that adjustment can be planned prior to installation.

2. Layout, Grading and Soil Preparation: Per specifications, the Landscape Contractor shall be responsible for transporting, spreading and mechanically incorporating a 2 inch depth of organic material, such as peat moss or well decomposed compost into the surface 4 inches of tilled existing or replaced topsoil on all areas to be planted to either turfgrass or landscape plant materials such as trees, shrubs, flowers and ground covers. The Landscape Architect, Landscape Contractor, COTR and/or COTR, and NCA's Chief Agronomist (or appropriate MSN Agronomist as requested by the Chief Agronomist) shall review the extent of this work prior to commencement of installation.

   - The Landscape Contractor shall be responsible for the collection and submission for testing of an adequate number of soil samples to fully characterize the soil fertility and pH profile of the soil at the site. Samples shall be submitted to a reputable soil testing laboratory several weeks prior to the commencement of any planting operations and copies of the soil analysis reports shall be provided to the COTR and /or COTR and NCA's Chief Agronomist or MSN Agronomist. The Landscape Contractor shall then be responsible for applying the soil analysis report recommended quantities of phosphoric acid, potash and/or limestone and thoroughly incorporating those materials to a minimum depth of 4 inches in the planting area topsoil.

   - The Landscape Contractor shall be responsible for accurately laying out the plant beds and turfgrass lawn areas by scaling the Drawings. Layout shall be painted or staked on the ground for review and approval by the COTR and/or COTR prior to excavation. Following approval of the layout, closely coordinate the installation of the irrigation system to conform to the approved layout.

   - The Landscape Contractor shall be responsible for cleanup and final grading of all areas to be established to turfgrass. The Landscape Contractor and COTR and/or COTR shall review the

extent of cleanup and grading prior to commencing work. All areas to be established to turfgrass whether by seeding, sodding or sprigging shall be raked smooth, removing and disposing of stones of 1 inch diameter or greater and fine graded to feather into the natural grade. The finished surface is properly described as **fine textured and firm**. The firmness test requires that surface soil not be fluffy or powdery and will support the weight of an average adult person without creating a visible depression. This condition most often requires that the site be rolled with an appropriately weighted turfgrass roller. All areas shall be fine graded to achieve positive surface drainage without puddles or standing water.

- The Landscape Contractor shall be responsible for erosion control of sloped areas.

- Weed Control: The Landscape Contractor shall be responsible for the elimination of all unwanted vegetation on the site prior to the commencement of planting operations. This shall be accomplished by applying glyphosate at the maximum label rate allowed by the EPA registered label for the total control of all types of perennial vegetation at least 2 weeks prior to the anticipated commencement of planting operations.

3. Plant Warranty: Contractor shall provide a one-year replacement warranty for all plant materials. Warranty shall cover plants that have died or partially died (thereby ruining their natural shape), but shall not include damage by vandalism, browsing, hail, abnormal freezes, drought or negligence by the Owner. The Warranty is intended to cover Contractor negligence, insect infestations, plant disease and damage or shock to plants. Plants replaced under the Warranty will be warranted for one year from the date of replacement.

Plant Material Selection and Planting Requirements

1. The Landscape Plant Materials selected for all NCA cemetery construction projects must be approved by the COTR and/or COTR in direct consultation with NCA's Chief Agronomist and appropriate MSN Agronomist. In general all plant material selections must be regionally adapted to the climatic conditions that exist at the site, be of appropriate mature dimensions to fit the planting location and be low maintenance species. This low maintenance requirement will generally exclude or at minimum severely limit the use of rose plants, wild flowers and ground covers. Any exceptions to these specie exclusions/limitations must be specifically approved by the COTR and/or COTR in consultation with the NCA Chief Agronomist and appropriate MSN Agronomist.

2. Plants: All plants shall be nursery grown, Grade 1 plants meeting American Nursery and Landscape Association standards typical in shape and size for the species. Plants shall not be root-bound or loose in their containers. Handle all plants with care in loading, unloading, and transporting. **Never pick-up or move tree species by grasping the trunk**. This seriously damages the young bark tissue and often results in eventual tree death. Trees must be picked up or moved by lifting the root soil ball, box or container.

3. Planting Beds and Planting Pits: The Landscape Contractor shall fully excavate plant beds as required to accommodate an approximate 3 inch layer of mulch. Stones of 1 inch diameter or larger shall be removed and disposed of off-site. The optimum planting backfill material for all plant species is the topsoil retained from the excavated beds and/or pits. If the available topsoil is of very poor quality it can be amended by thoroughly mixing it with one part peat moss for every three parts of topsoil.

4. Planting Operations: Large container sizes, boxed or balled and burlapped plants shall be planted in pits no less than 2 and preferably 3 times as wide as the plants soil ball/container. The proper depth of the planting hole must allow placement of the plant soil ball on undisturbed soil that results in the location of the tree's root flare slightly above final soil grade. The root flare should never be placed at a location where it is below the finished soil grade. The Landscape Contractor shall be responsible for ensuring the placement of all plants with their best side facing the nearest cemetery road. Use the total quantity of landscape plants per the landscape specifications and obtain final approval of plant material lay-out from the COTR and/or COTR in consultation with NCA's Chief Agronomist or appropriate MSN Agronomist.

5. Planting Bed Edging: No artificial material such as steel strips, bricks, or landscape timbers is to be installed as edging for finished plant beds or tree pit mulch surrounds. The turfgrass established at the site mowed at its proper maintenance height will serve as the edge material for all planting beds and tree pit mulch surrounds.

6. Mulch: Following planting and proper backfilling all planting beds and tree pits shall be mulched with an approximate 3 inch layer of shredded wood fiber mulch. Mulch must not be mounded at the base of newly planted trees and the finished depth of the mulch at the edge of planting beds and tree mulch surrounds should be slightly below the anticipated turfgrass mowing height. This allows mowing maintenance equipment to pass above the mulch edge without interference or mulch disturbance.

Turfgrass Species Selection for Seeding, Sodding or Sprigging

General Considerations

Turfgrass species approved for use on NCA cemeteries are limited to a select number of regionally adapted species that deliver acceptable turfgrass quality and appearance when provided with a level of maintenance consistent with NCA's Standard Operating Procedures for Turfgrass and Landscape Maintenance as specified in NCA Handbook 3420. These species are divided into two broad categories based on regional climatic adaptation.

- Cool Season Turfgrasses are best adapted to the cool humid climatic zones of the United States. They include Kentucky bluegrass, perennial ryegrass, fine fescue and tall fescue. **No other species are permitted.**

- Warm Season Turfgrasses are best adapted to the warm humid climatic zones of the United States and with adequate irrigation the warm/hot arid or semi-arid areas. They include bermuda grass, St. Augustine grass and bahia grass. **No other species are permitted.**

Specific Seed Mixture and Sod Composition Guidelines

Seed Mixtures: Composition is % by Weight

Cool Season: Preferred mixture-50% perennial ryegrass (a blend of 2 regionally adapted cultivars)
30% Ky. bluegrass (a blend of 2 regionally adapted cultivars)
20% fine fescue (a blend of 2 regionally adapted cultivars)
Seeding Rate = 6 lb /1000 sq.ft.
Secondary mixture- 50% tall fescue (a blend of 2 regionally adapted cultivars)
50% perennial ryegrass (a blend of 2 regionally adapted cultivars)
Seeding Rate = 10 lb/1000 sq.ft.

Warm Season: Preferred mixture, sunny locations- seeded bermuda grass – use a blend that contains 2 or 3 cultivars from this list: Sunsport, Princess, Riviera, Southern Star, Blackjack, Savannah, Primo Blend

Seeding Rate = 2 lb/1000 sq.ft. (hulled seed)
Preferred species, shady locations- St. Augustine grass – sod only
Secondary/low visibility areas - Bahia grass
Seeding Rate = 8 lb/1000 sq.ft. (scarified seed)

Turfgrass Sod Composition:

On projects where commercially grown sod is specified select a turfgrass species composition that roughly approximates one of the above seed mixtures. St. Augustine grass can only be established by sodding.

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SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK:

A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.

B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.

C. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.

1.3 QUALITY ASSURANCE:

A. Products Criteria:

1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS:

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturers' Literature and Data: Submit the following as one package:

1. Piping.
2. Jointing material.
3. Manhole, inlet and catch basin material.
4. Frames and covers.
5. Steps.
6. Resilient connectors and downspout boots.

C. One copy of State Department of Transportation standard details of MANHOLES, INLETS and catch basins.

D. One copy of State Department of Transportation specification.

1.5 APPLICABLE PUBLICATIONS:

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A48-03/A48M-03.....Gray Iron Castings

A536-84(2004).....Ductile Iron Castings

A615-05/A615M-05.....Deformed and Plain-Billet Steel Bars for Concrete Reinforcement

A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe

A742-03/A742M-03.....Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe

A760-01a/A760M-01a.....Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

A762-00/A762M-00.....Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains

A798-01/M798M-01.....Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications

A849-00.....Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

A929-01/A929M-01.....Steel Sheet, Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe

C76-05a/C76M-05a.....Reinforced Concrete Culvert, Storm Drain and Sewer Pipe

C139-03.....Concrete Masonry Units for Construction of Catch Basins and Manholes

C150-04ae1.....Portland Cement

C443-05/C443M-05.....Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C478-03a/C478M-03a.....Precast Reinforced Concrete Manhole Sections

C506-05/C506M-05.....Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe

C507-05a/C507M-05a.....Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe

C655-04e1/C655M-04e1....Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe

C1433-04e1/C1433M-04e1..Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe Lines
C857-95(2001).....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C923-02/C923M-02.....Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials
C924-02/C924M-02.....Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
C1103-03/C1103M-03.....Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
D698-00ae1.....Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
D1056-00.....Flexible Cellular Materials-Sponge or Expanded Rubber
D2412-02.....Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
D2321-04e1.....Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .
D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3212-96a(2003)e1.....Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
D3350-04.....Polyethylene Plastics Pipe and Fittings Materials
D4101-05a.....Polypropylene Injection and Extrusion Materials
F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F679-03.....Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
F794-03.....Poly (Vinyl Chloride)(PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
F894-98a.....Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior
F1417-92(2005).....Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
NOTE: ASTM test methods shall be the current version as of the date of advertisement of the project.

C. American Association of State Highway and Transportation Officials (AASHTO):
HB17.....Standard Specifications for Highway Bridges
M190-04.....Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
M198-05.....Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
M294-04.....Corrugated Polyethylene Pipe, 300-1500 mm (12 to 60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):
1. Concrete:
a. Reinforced pipe, ASTM C76. Class V, or ASTM C655, 1350 lbs/lf per 1 foot inside dia. Joints shall be watertight flexible joints made with rubber-type gaskets conforming to ASTM C443.
2. Polyvinyl Chloride (PVC):
a. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.
b. Pipe and fittings, smooth wall, corrugated or ribbed PVC, shall conform to the following:
1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth interwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 345 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D 2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.

2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794, Series 46. Ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.

3) Solid wall pipe and fittings shall conform to ASTM F 679, SDR 35 pipe and fittings shall gaskets conforming to ASTM F 477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).

3. High Density Polyethylene (HDPE):

a. Smooth Wall PE Pipe: Shall comply with ASTM F714, DR 21 for pipes 75 to 600 mm (3 to 24 inches), and SDR 26 for pipes 650 to 1200 mm (26 to 48 inches). Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

b. Corrugated PE Pipe: Shall comply with Type S for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm^4/mm (in^4/in)
300 mm (12 in)	3200 mm^2/m (1.50 in^2/ft)	390 (.024)
375 mm (15 in)	4000 mm^2/m (1.91 in^2/ft)	870 (.053)
450 mm (18 in)	4900 mm^2/m (2.34 in^2/ft)	1020 (.062)
600 mm (24 in)	6600 mm^2/m (3.14 in^2/ft)	1900 (.116)
750 mm (30 in)	8300 mm^2/m (3.92 in^2/ft)	2670 (.163)
900 mm (36 in)	9500 mm^2/m (4.50 in^2/ft)	3640 (.222)
1050 mm (42 in)	9900 mm^2/m (4.69 in^2/ft)	8900 (.543)
1200 mm (48 in)	10900 mm^2/m (5.15 in^2/ft)	8900 (.543)
1350 mm (54 in)	12000 mm^2/m (5.67 in^2/ft)	13110 (.800)
1500 mm (60 in)	13650 mm^2/m (6.45 in^2/ft)	13110 (.800)

c. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm^4/mm (in^4/in)
450 mm (18 in)	6300 mm^2/m (2.96 in^2/ft)	850 (.052)
525 mm (21 in)	8800 mm^2/m (4.15 in^2/ft)	1150 (.070)
600 mm (24 in)	9900 mm^2/m (4.66 in^2/ft)	1330 (.081)
675 mm (27 in)	12500 mm^2/m (5.91 in^2/ft)	2050 (.125)
750 mm (30 in)	12500 mm^2/m (5.91 in^2/ft)	2050 (.125)
825 mm (33 in)	14800 mm^2/m (6.99 in^2/ft)	2640 (.161)
900 mm (36 in)	17100 mm^2/m (8.08 in^2/ft)	3310 (.202)
1050 mm (42 in)	16500 mm^2/m (7.81 in^2/ft)	4540 (.277)
1200 mm (48 in)	18700 mm^2/m (8.82 in^2/ft)	5540 (.338)

4. Corrugated Steel Pipe:
   a. Zinc/Aluminum Coated: Pipe shall comply with ASTM A760, zinc or aluminum (Type 2) coated of either:
      1) Type II pipe with helical 68 by 13 mm (2-2/3 by 1/2 inch) corrugations.
      2) Type IIR pipe with helical 19 by 19 by 190 mm (3/4 by 3/4 by 7-1/2 inch) corrugations.
   b. Internal coatings shall be Fully bituminous coated (AASHTO M190 Type A) Fully bituminous coated, Part Paved (AASHTO M190 Type C)
   c. Concrete Lined: Zinc coated Type I corrugated steel pipe with helical 68 by 13 mm (2-2/3 by 1/2 inch) corrugations shall comply with ASTM A760. Concrete lining shall comply with ASTM A849.
   d. Polymer Precoated: ASTM A762 corrugated steel pipe fabricated from ASTM A742, Grade 250/250 10/10 polymer precoated sheet of either:
      1) Type II pipe with helical 68 by 13 mm (2-2/3 by 1/2 inch) corrugations.
      2) Type IIR pipe with helical 19 by 19 by 190 mm (3/4 by 3/4 by 7-1/2 inch) corrugations.
   e. Internal coatings shall be polymer precoated, part paved (AASHTO M190, Type B modified).

2.2 JOINTING MATERIAL:

A. Concrete Pipe: Rubber gasket ASTM C443.

B. Polyvinyl Chloride (PVC) Pipe:
   1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.

C. PE Plastic Pipe:

1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
2. Corrugated PE Plastic Pipe: Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.

D. Corrugated Metal Pipe:
1. Gaskets: Rubber gaskets, shall comply with ASTM D1056, Type 2 A1 Rubber O-rings shall conform to ASTM C443.
2. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of the band, and the size of the angles, bolts, rods and lugs as indicated, or where not indicated, as specified in the applicable standards or specifications for the pipe.

2.3 MANHOLES, INLETS AND CATCH BASINS:

A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:
1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top

sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.

4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
6. Mortar:
   a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, l/4 part lime hydrate, and 3 parts sand.
   b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-l/2 gallons) per sack of cement.
7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.
8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words “storm sewer”. The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the mall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).

B. Prefabricated Corrugated Metal Manholes: Manholes shall be the type and design as indicated on the drawings and as recommended by the manufacturer.

C. Prefabricated Plastic Manholes and Drain Basins: Plastic manholes and drain basins shall be as indicated on the drawings.

D. Frame and Cover for Gratings: Frame and cover for gratings shall be cast gray iron conforming to ASTM A48; cast ductile iron conforming to ASTM A536 in accordance with State Department of Transportation standard details Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 HEADWALLS:

A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 CONCRETE:

Concrete shall be in accordance with Tennessee Department of Transportation standard specification 702. For concrete not specified in above standards, concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.6 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.7 FLARED END SECTIONS:

Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.8 PRECAST REINFORCED CONCRETE BOX.

Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

2.9 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.10 WARNING TAPE:

Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape non-detectable type, purple with black letters, and imprinted with “CAUTION BURIED STORM SEWER BELOW”.

PART 3 – EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING:

The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.3 GENERAL PIPING INSTALLATION:

A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
G. Do not lay sewer pipe in same trench with another pipe or other utility.

H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.

I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:

1. Reinforced Concrete Pipe: Comply with manufacturer’s recommendations with gasketed joints.
2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
3. High Density Polyethylene (HDPE) Piping: Comply with manufacturer’s recommendations with gasketed joints.
4. Corrugated Metal Pipe: ASTM A798.

J. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

3.4 REGRADING:

A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 MANHOLES, INLETS AND CATCH BASINS:

A. General:

1. Circular Structures:
   a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
   b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and

top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.

c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:
   a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
   b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
   a. Forming directly in concrete base of structure.
   b. Building up with brick and mortar.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer’s recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300

mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

Reinforced concrete or ADS as shown or precast concrete.

3.8 INSPECTION OF SEWERS:

Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.9 TESTING OF STORM SEWERS:

A. Gravity Sewers:

1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
2. Pipe not passing air testing will be replaced by the Contractor at no additional cost to the Government. Re-test replaced pipe to show compliance with air test.

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SECTION 33 46 13
FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 DESCRIPTION

This section specifies foundation drainage system, including installation, backfill, and cleanout extensions, to place of connection to storm sewer.

1.2 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Samples: For each type of filter fabric, pipe, and fitting indicated

C. Product Data: Certifications from the manufacturers attesting that materials meet specification requirements.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01 45 29, TESTING LABORATORY SERVICES.

B. Safety requirements: Section 00 72 00, GENERAL CONDITIONS, Article, ACCIDENT PREVENTION.

C. Protection of existing utilities, fire protection services, existing equipment, roads, and pavements: Section 01 00 00, GENERAL REQUIREMENTS.

D. Subsurface Investigation: Section 01 00 00, GENERAL REQUIREMENTS, Article, PHYSICAL DATA.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred in the text by basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

HB17-02.....Standard Spec for Highway Bridges, Div II, Section 36.4.2.4, Joint Properties.

M6-03.....Fine Aggregate for Portland Cement Concrete

M86/M86M-06.....Concrete Sewer, Storm Drain, and Culvert Pipe

M175/M175M-05.....Perforated Concrete Pipe

M288-06.....Geotextile Specification for Highway Applications

T281-06.....Vitrified Clay Pipe

C. American Society for Testing and Materials (ASTM):

A74-05.....Standard Specification for Cast Iron Soil Pipe and Fittings

A746-03.....Standard Specification for Ductile Iron Gravity Sewer Pipe

C14/C14M-05a .....Standard Specification for Non-reinforced Concrete Sewer, Storm Drain, and Culvert Pipe

C118/C118M-05a.....Standard Specification for Concrete Pipe for Irrigation or Drainage

C443/C443M-05a.....Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

C444/C444M-03.....Standard Specification for Perforated Concrete Pipe

D448-03a.....Standard Classification for Sizes of Aggregate for Road and Bridge Construction

D2321-05.....Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2729-03.....Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D2737-03.....Standard Specification for Polyethylene (PE) Plastic Tubing

D3034-06.....Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

D4216-03.....Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Related PVC and Chlorinated Poly (Vinyl Chloride) (CPVC) Building Products Compounds

F477-02e1.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F758-95(2000) .....Standard Specification for Smooth-Wall Poly (Vinyl Chloride)(PVC)Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Perforated Drainage Pipe:

1. Perforated, PE pipe and fittings per ASTM D2737, in NPS 4 to NPS 6 (DN 100 to DN 150). Joints shall be coupling type.

B. Cleanout Extension: ASTM A74, cast iron pipe or ASTM A746 ductile iron. Gravity Sewer pipes shall have a neoprene gasket joints and long sweep elbow fittings.

C. Drainage Conduit:
1. Pipe, fittings, and couplings shall be perforated and smooth PVC complying with ASTM D4216 and ASTM D2729.
2. Pipe size shall be 200 mm (8 inches) and have a high minimum flow rate equal to a NPS 4 (DN 100) pipe.
3. Fittings shall be PVC with NPS 4 (DN 100) outlet connection.
4. Couplings shall be PVC.

D. Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with the following properties determined according to AASHTO M 288:

E. Drainage Mat: Formed three dimensional polyethylene or high-impact polymeric core or compression-resistant nylon matting of open three-dimensional construction.

F. Drainage Material:
1. Bedding: Crushed stone, 20 mm (3/4 inch) to No. 4 per ASTM D448.
2. Fill to 300 mm (1 foot) above pipe: Crushed stone, 20 mm (3/4 inch) to No. 4 per ASTM D448. See plan details.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Laying: Prior to installation of bedding materials or piping, examination of excavation and subgrades are to be observed by the Cotr. Invert elevation of drain pipe shall not be higher than top of lowest floor elevation nor lower than a 45 degree line projected from bottom of any adjacent footing. Lay drain lines and firmly bed in granular material a minimum of 75 mm (3 inches) below invert to top of pipe to true grades and alignment with bells facing upgrade, and to slope uniformly between elevations shown on foundation drainage drawings. Keep trenches dry until pipe is in place and granular material backfill is completed to 300 mm (1 foot) above top of pipe, unless otherwise noted.

1. Install gaskets, seals, sleeves, and couplings according to manufacturers written instructions and per the applicable standard:
   a. PE and PVC pipe installation shall be per ASTM D2321 and ASTM F758.
   b. Concrete piping shall be per ASTM C14/C14M, AASHTO M86/M86M, and ASTM C118/C118M.
   c. PE joint construction shall be per ASTM D2737 and AASHTO HB17, Division II, Section 26.4.2.4, “Joint Properties.”
   d. PVC joint construction shall be per ASTM D3034 with elastomeric seals gaskets per ASTM D2321.
   e. Perforated PVC joint construction shall be per ASTM D2729, with loose bell and spigot joints.
   f. Perforated concrete joint construction, including fittings and gaskets, shall be per ASTM C443/C443M.
2. Lay perforated pipe with perforations down. Lay plain end pipe with closed joints held in place with two No. 9 spring steel wire clips at each joint or by standard clay collars.
3. For foundation subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 900 mm (3 feet), unless otherwise indicated.
4. For underslab subdrainage, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
5. Install cleanout extensions where shown on the Contract Documents.
6. Prior to backfilling, check drain lines to assure free flow. Remove obstructions and recheck lines until satisfactory.

B. Backfilling: Place a minimum of 300 mm (12 inches) of granular material, hand tamped, extending in width a minimum of 600 mm (2 feet) from building wall. Then place a minimum of 150 mm (6 inches) of concrete sand, well tamped. Continue backfill with pit run sand and gravel with a maximum plasticity index of 6 to within 900 mm (3 feet) of finished grade in planting areas. Remainder of backfill shall be comparable to existing adjacent soils. In bituminous and concrete paving areas, backfill to the bottom of the base course with pervious material. Where foundation drain is within 600 mm (2 feet) of finished grade, one-half of fill shall be made with crushed stone.

C. Filter fabric may be substituted for sand layer.

D. Vertical drainage mat in conjunction with geotextile may be substituted for sand and drainage material.

E. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed and their location marked with wooden stakes.

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